FRESCO

BY MICHEL ANGELO.

The NATIONAL ENCYCLOPÆDIA

A DICTIONARY OF UNIVERSAL KNOWLEDGE.

BY

WRITERS OF EMINENCE IN

LITERATURE, SCIENCE, AND ART.

VOLUME VI.

LONDON.
WILLIAM MACKENZIE, 69 LUDGATE HILL, E.C.,
EDINBURGH, AND GLASGOW.

Elibron Classics series.

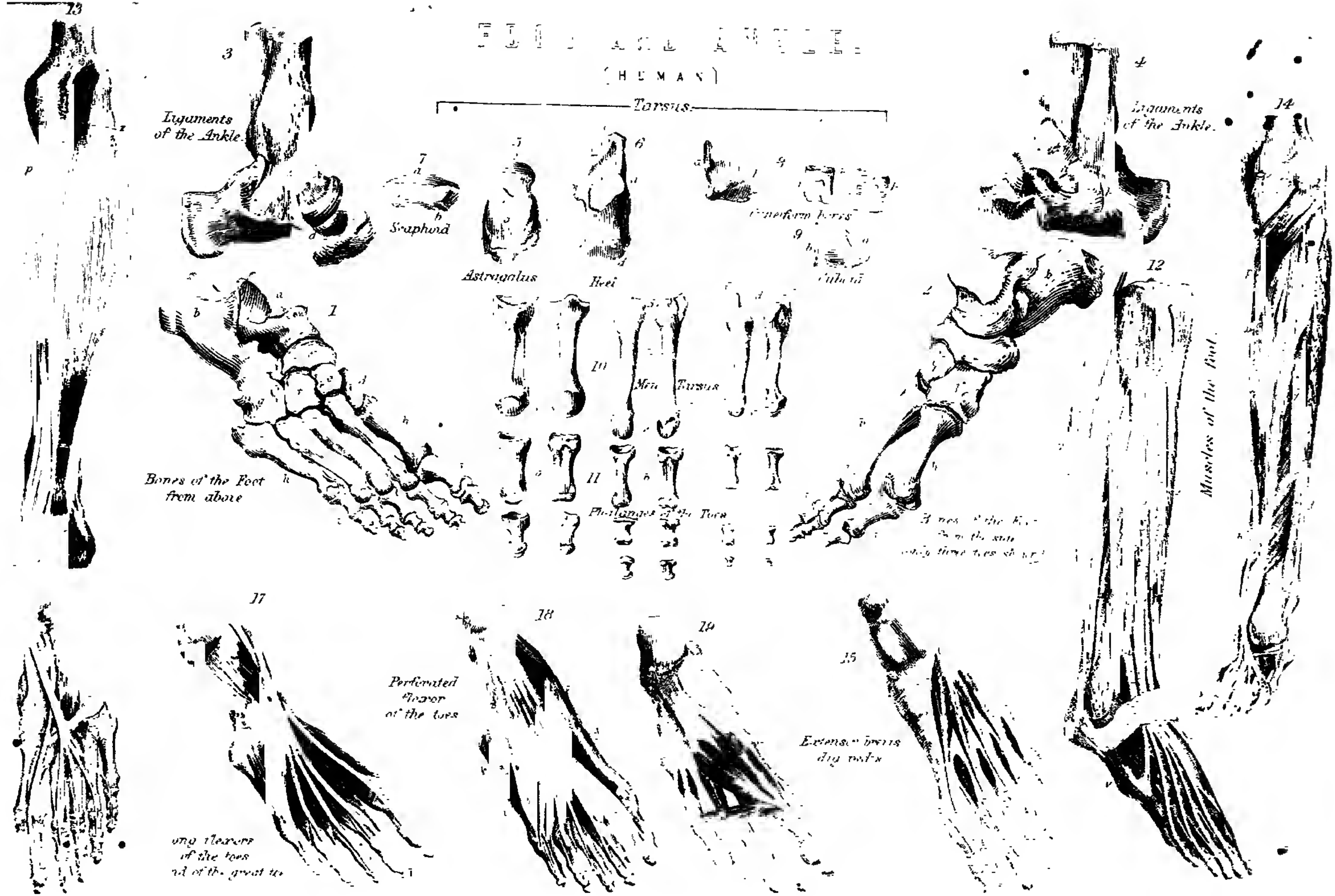
ISBN 0-543-88688-3 (paperback)
ISBN 0-543-88687-5 (hardcover)

This Elibron Classics Replica Edition is an unabridged facsimile
Of the edition published in 1875 by William Mackenzie, London.

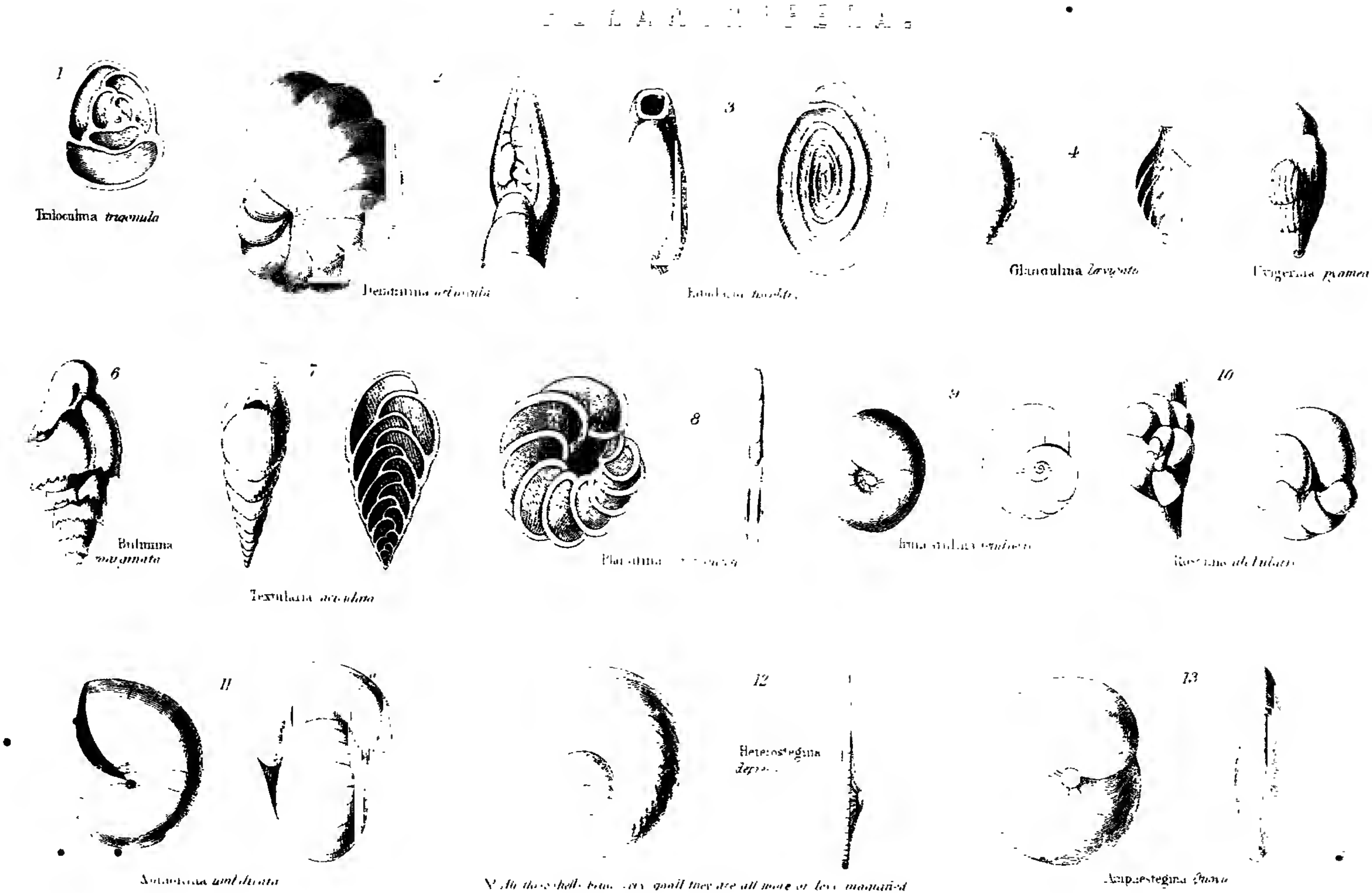
LIST OF PLATES.

VOL. VI.

To be Bound at Commencement of Volume in Following Order.



FOOT AND ANKLE
(HUMAN)
Tarsus
3
Ligaments of the Ankle
4
Ligaments of the Ankle
7
Scaphoid
5
Astragalus
6
Heel
9
Cuneiform bones
9
Cuboid
1
Bones of the Foot from above
2
Bones of the Foot from the side
10
Metatarsus
11
Phalanges of the Toes
12
14
Muscles of the foot
13
Muscles of the calf
17
Long flexors of the toes and of the great toe
18
Perforated flexor of the toes
19
15
Extensor brevis digitorum


1
Triloculina trigonula
3
4
Glandulina laevigata
Uvigerina pygmaea
6
Bulimina marginata
7
Textularia aculeata
8
10
11
12
Heterostegina
13

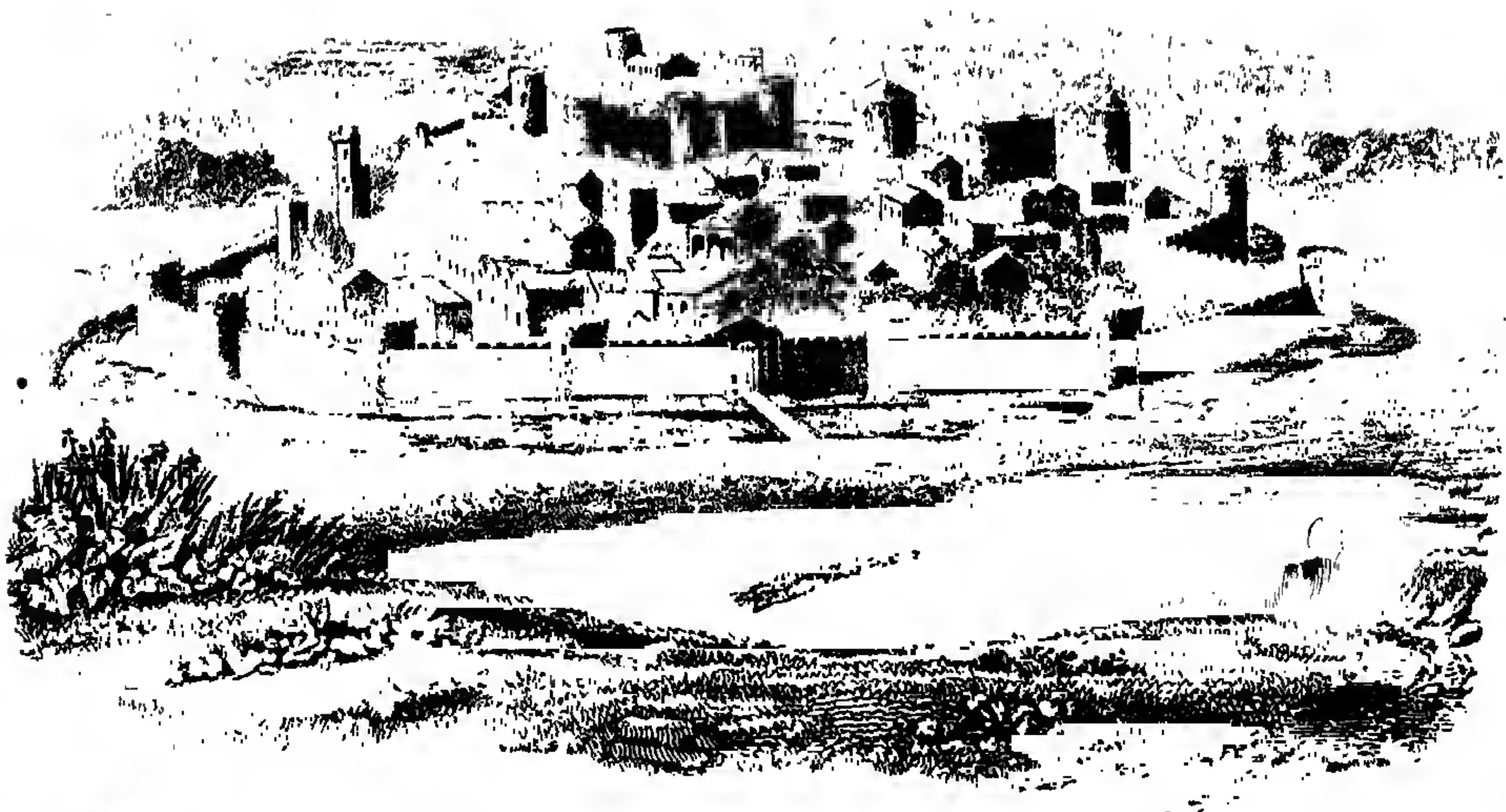


Fig. 1. GENERAL APPEARANCE OF ANCIENT FORTRESS

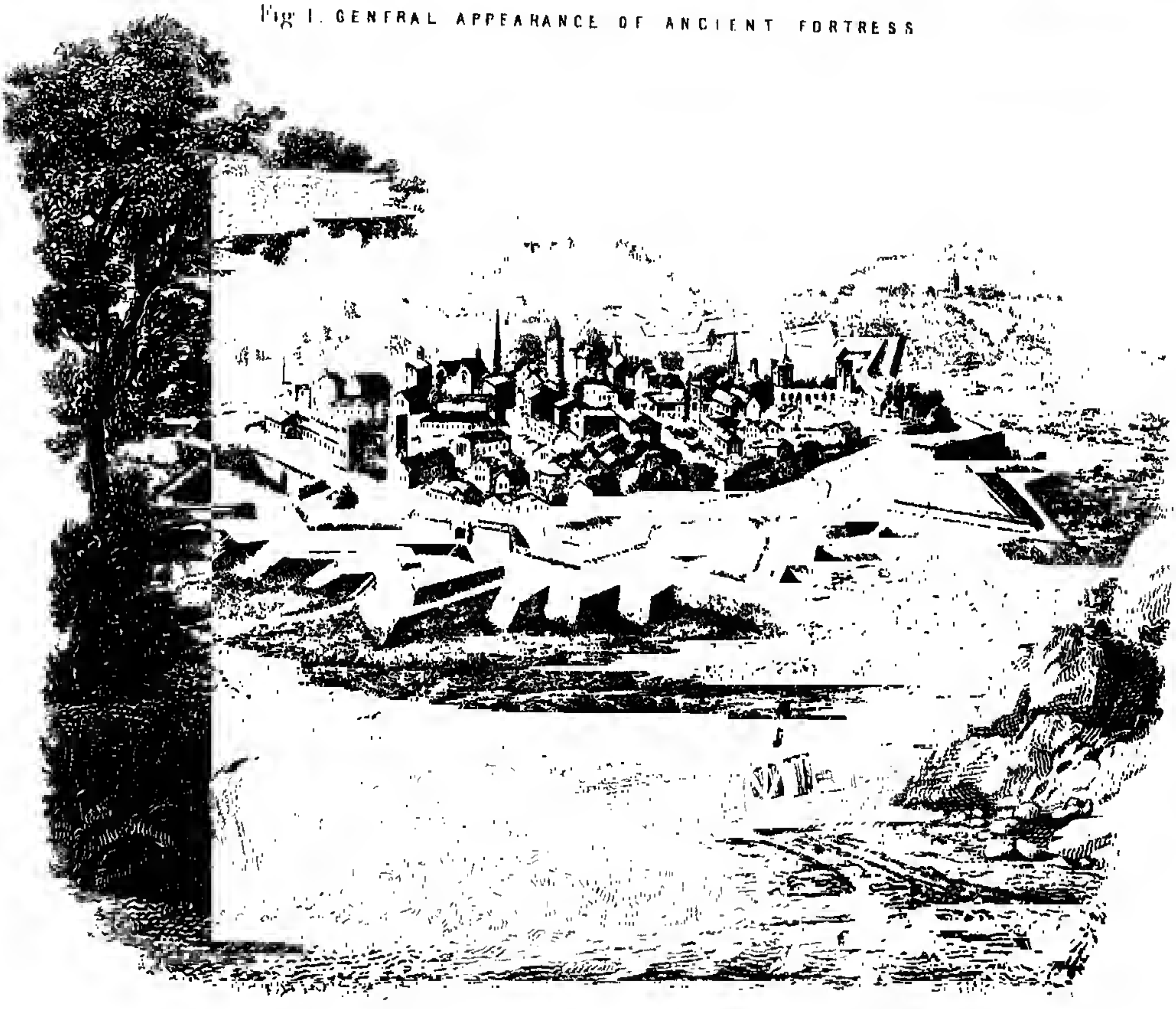
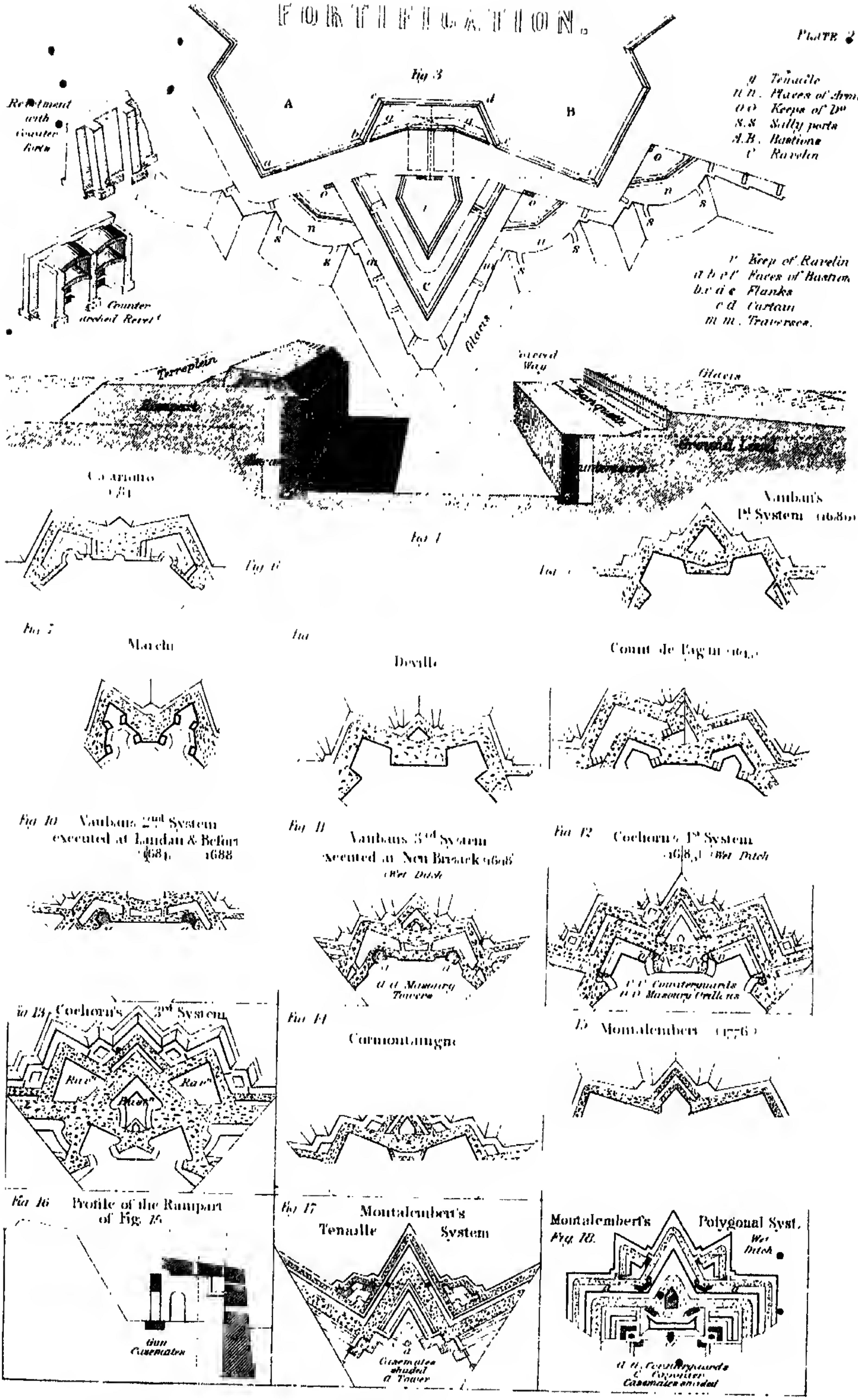
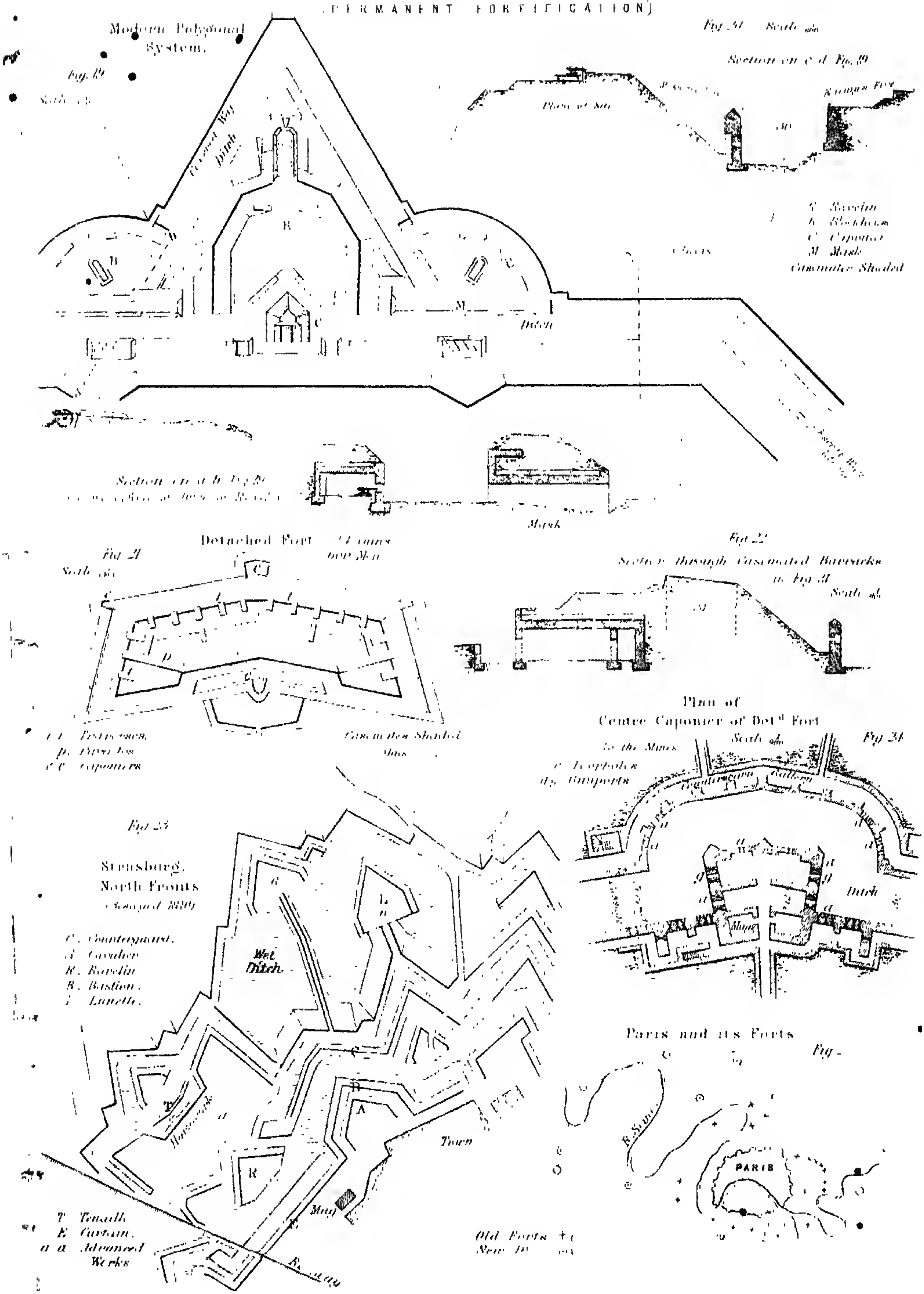


Fig. 2. GENERAL APPEARANCE OF BASTIONED FORTRESS

FORTIFICATION.

PLATE 2




Modern Polygonal System.
Fig. 19
Section on c d Fig. 19
R. Ravelin
B. Blockhouse
C. Caponier
M. Mask
Casemates Shaded
Covered Way
Ditch
Ditch
Section on a b Fig. 19
Mask
Detached Fort
Fig. 21
C. Caponiers
Casemates Shaded
Fig. 22
Section through Casemated Barracks
Plan of Centre Caponier of Det.d Fort
Fig. 24
Loopholes
Gunports
Ditch
Fig. 23
Strasburg, North Fronts
C. Counterguard
R. Ravelin
B. Bastion
L. Lunette
Wet Ditch
Town
Mag.
T Tenaille
E Curtain
a a Advanced Works
Paris and its Forts
R. Seine
PARIS
Old Forts
New Do.

FORTIFICATION

(COAST DEFENCES)

Fig. 26.

Fig. 27

Masonry Casemate. Iron Shields

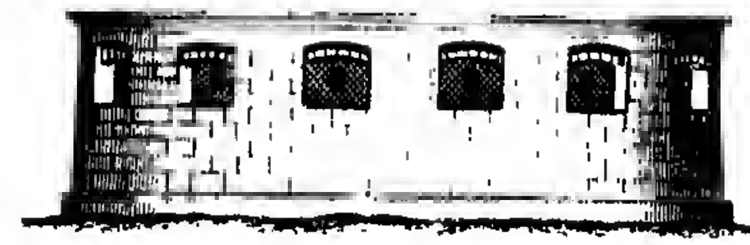


Fig 28. Earthen Battery, Iron Shields.

Fig 30. Plan of Casemate in Fig. 29.

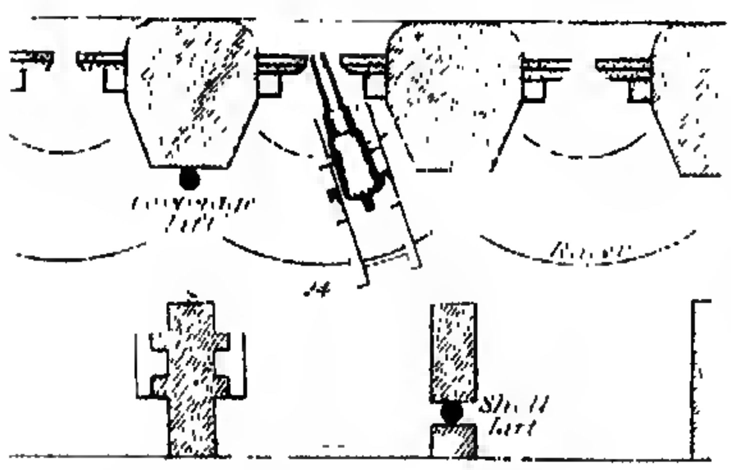
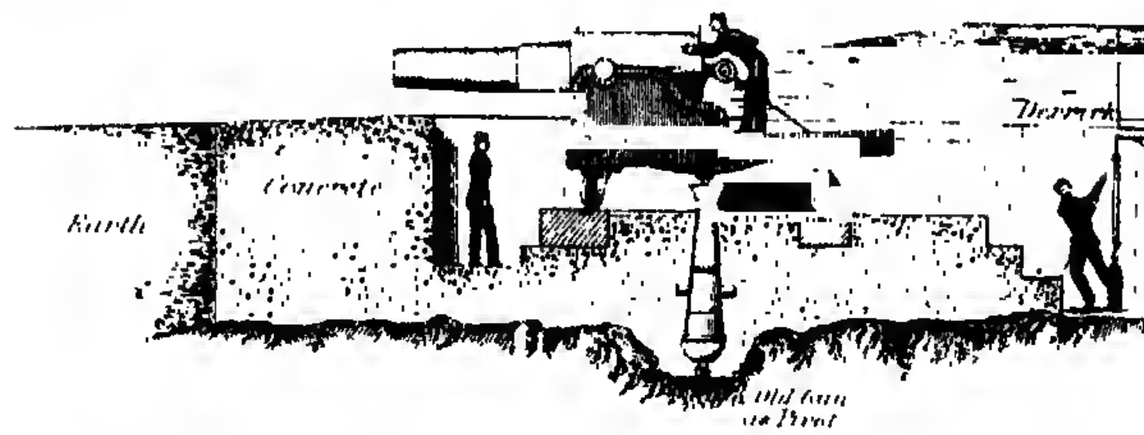


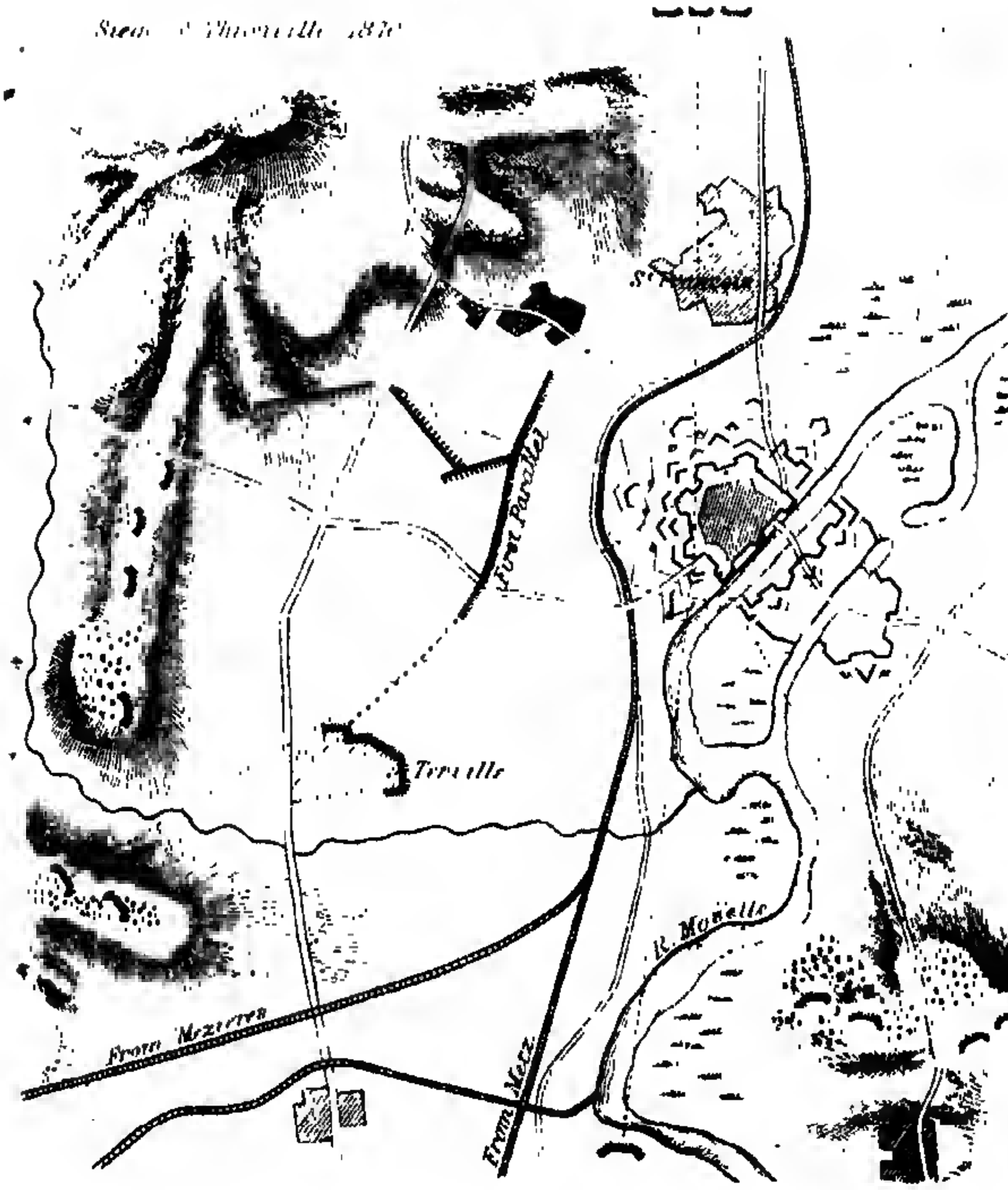
Fig 31. Section of Fig 29



ATTACK OF FORTRESSES

Fig. 32. Position of First Batteries.

Siege of Thionville 1870



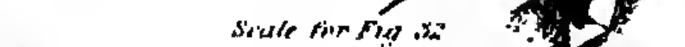


Fig. 33.

2-Gun Siege Battery

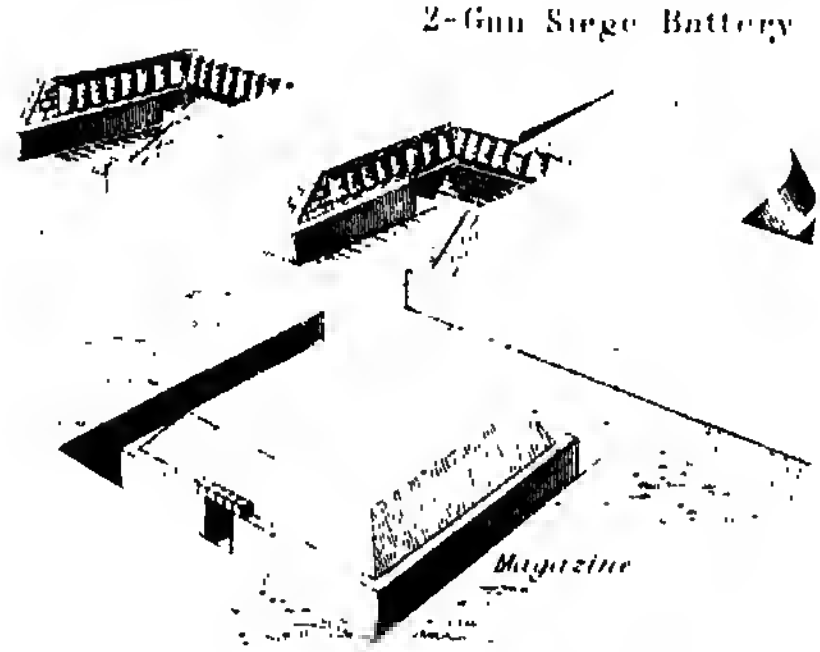


Fig 34. Section of Parallel

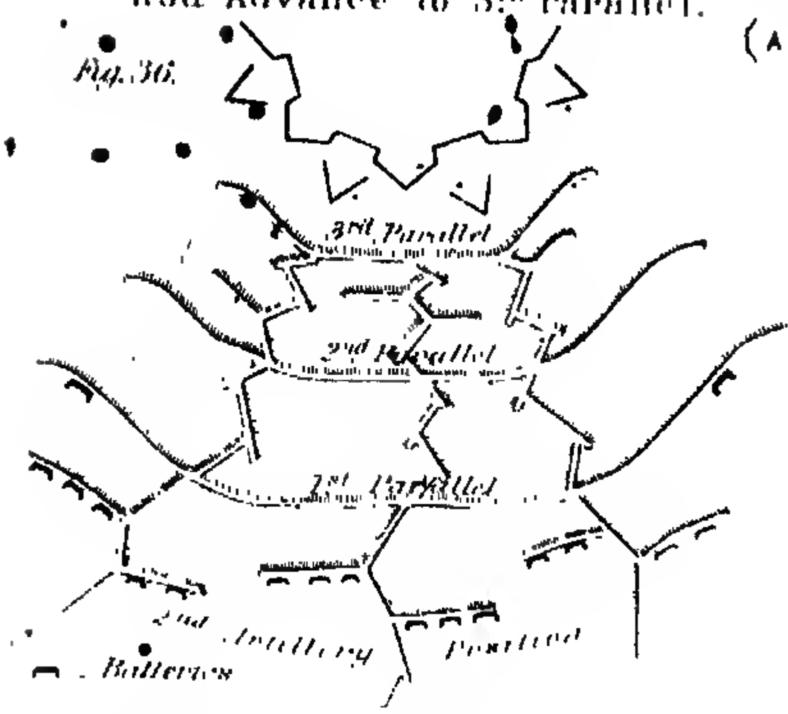
Fig 35. Sap.

FORTIFICATION.

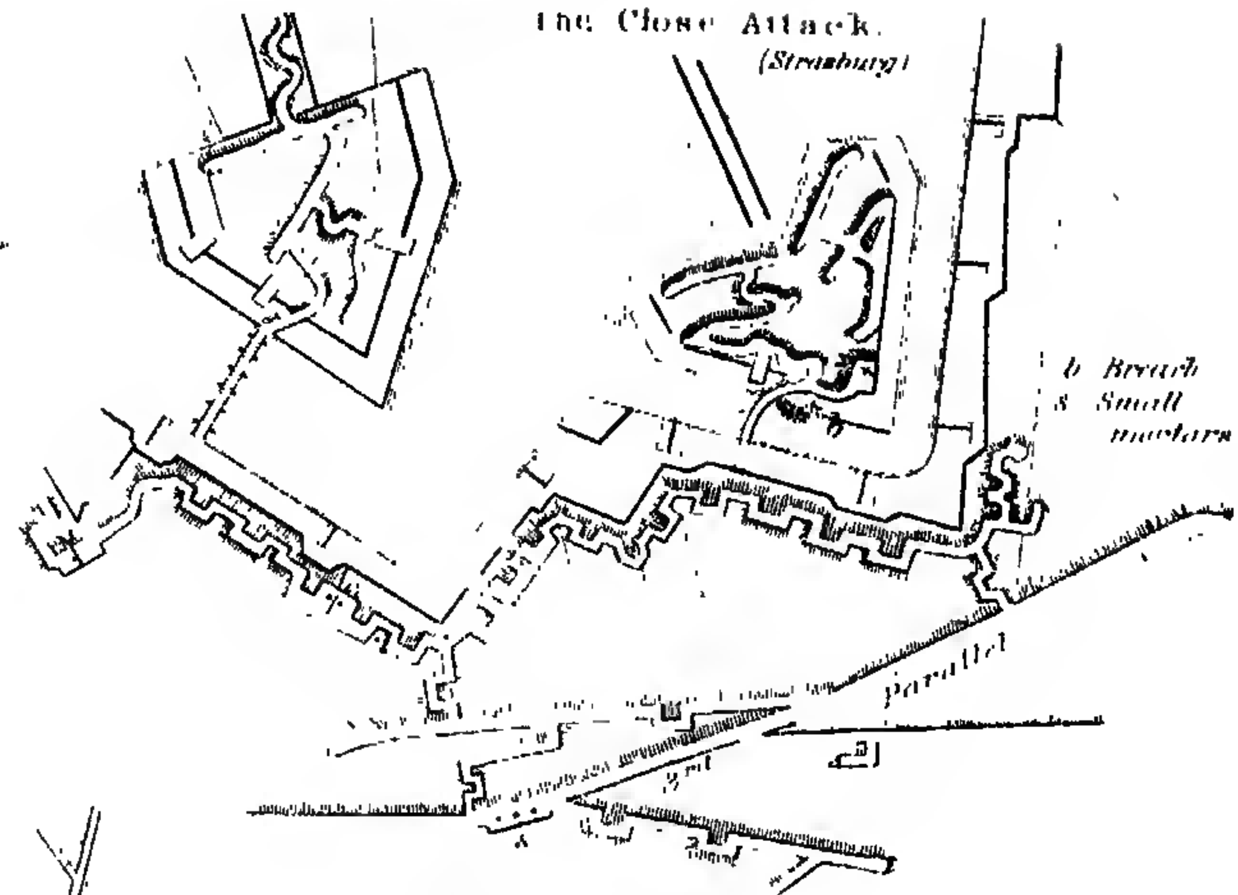
(ATTACK OF FORTRESSES)

The closer Batteries and Advance to 3rd Parallel.

Fig. 36.



The Close Attack. (Strasburg)



m Main Galleries
l Listeners

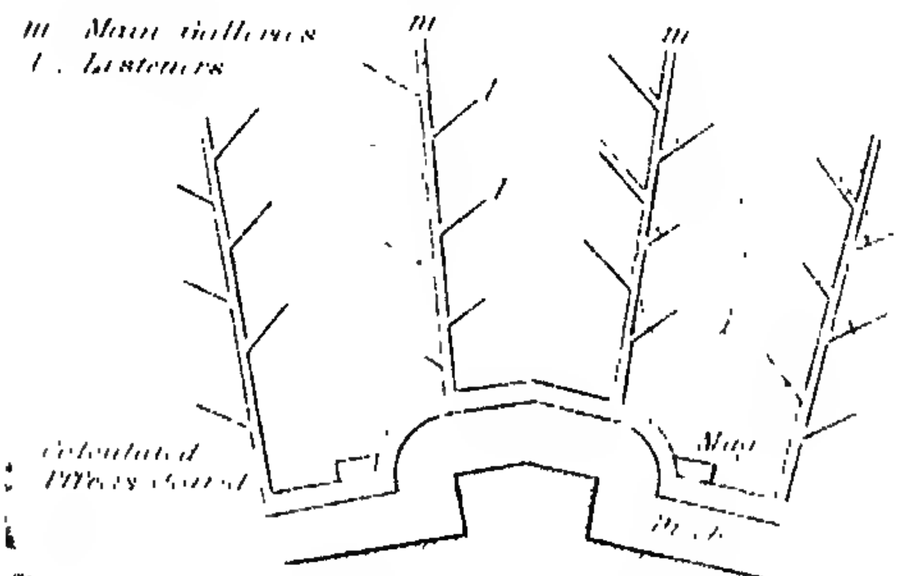


Fig. 38

System of Countermines at Salient of a Detached Fort

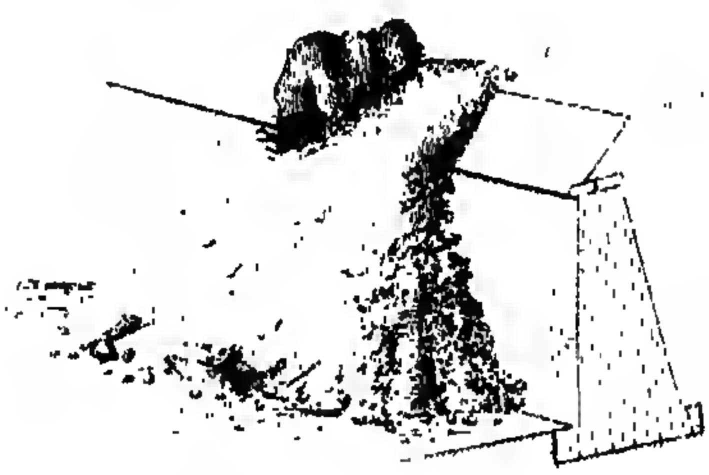


Fig. 39

Sketch of a Breach.

FIELD FORTIFICATION

Section of a Field Redoubt

Fig. 40.

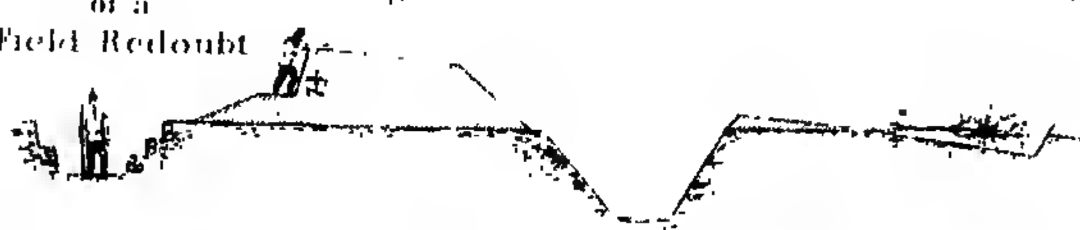


Fig. 41. Field Casemate.

Fig. 42. Gunpit

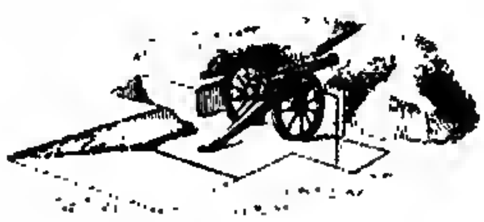


Fig. 43. Wire Entanglement

Military Pits

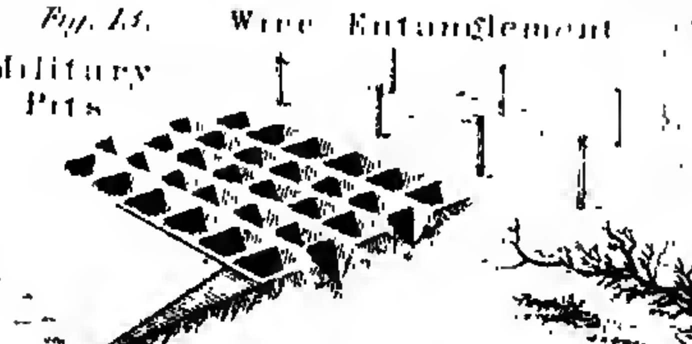
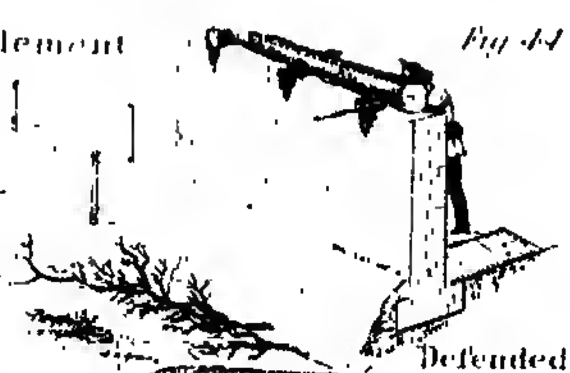


Fig. 44



Defended Wall

Fig. 45

Shelter Trench (1 Hour)

Defended Hedge

Fig. 46

Fig. 47

Continuous Line

Fig. 48 Line of Redoubts

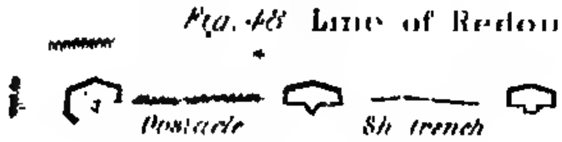
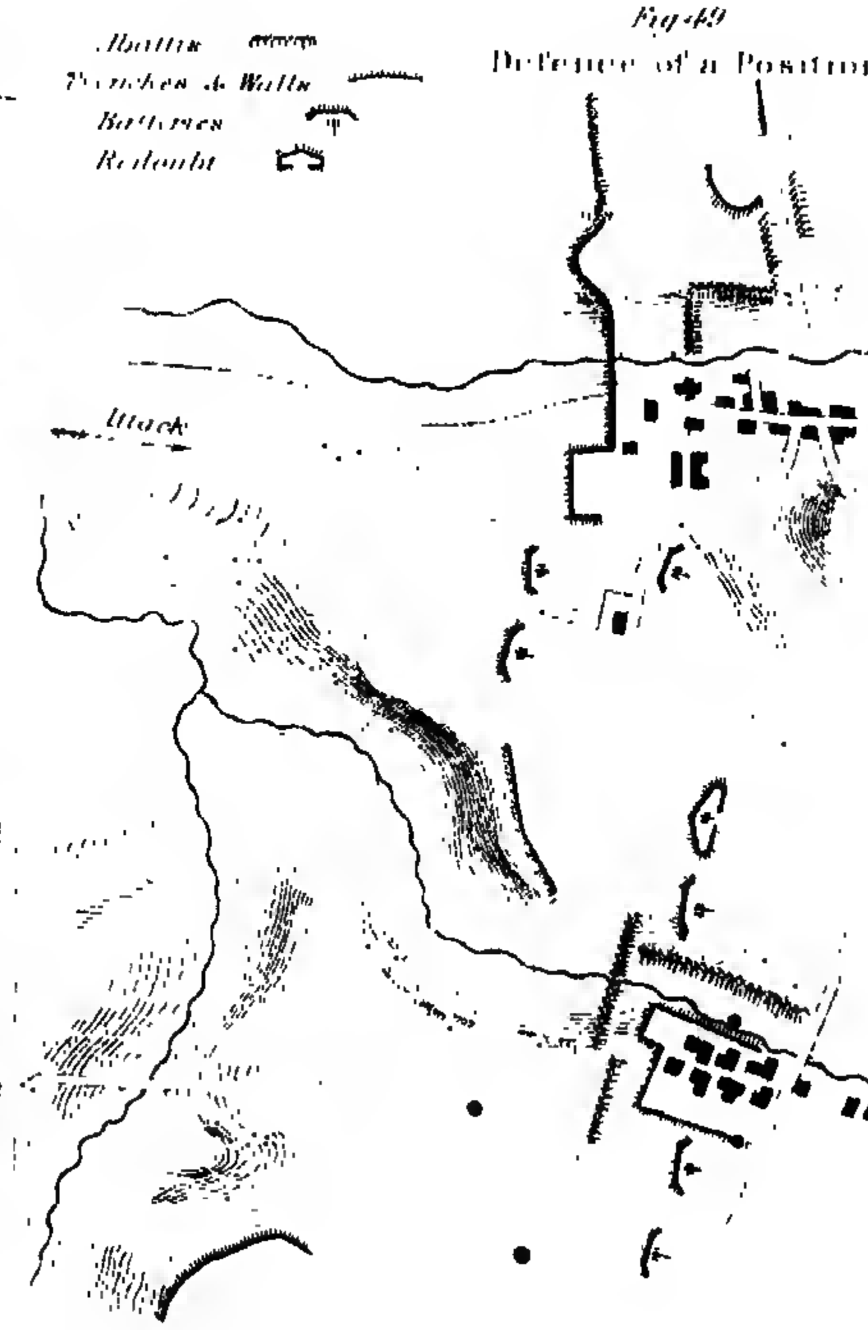
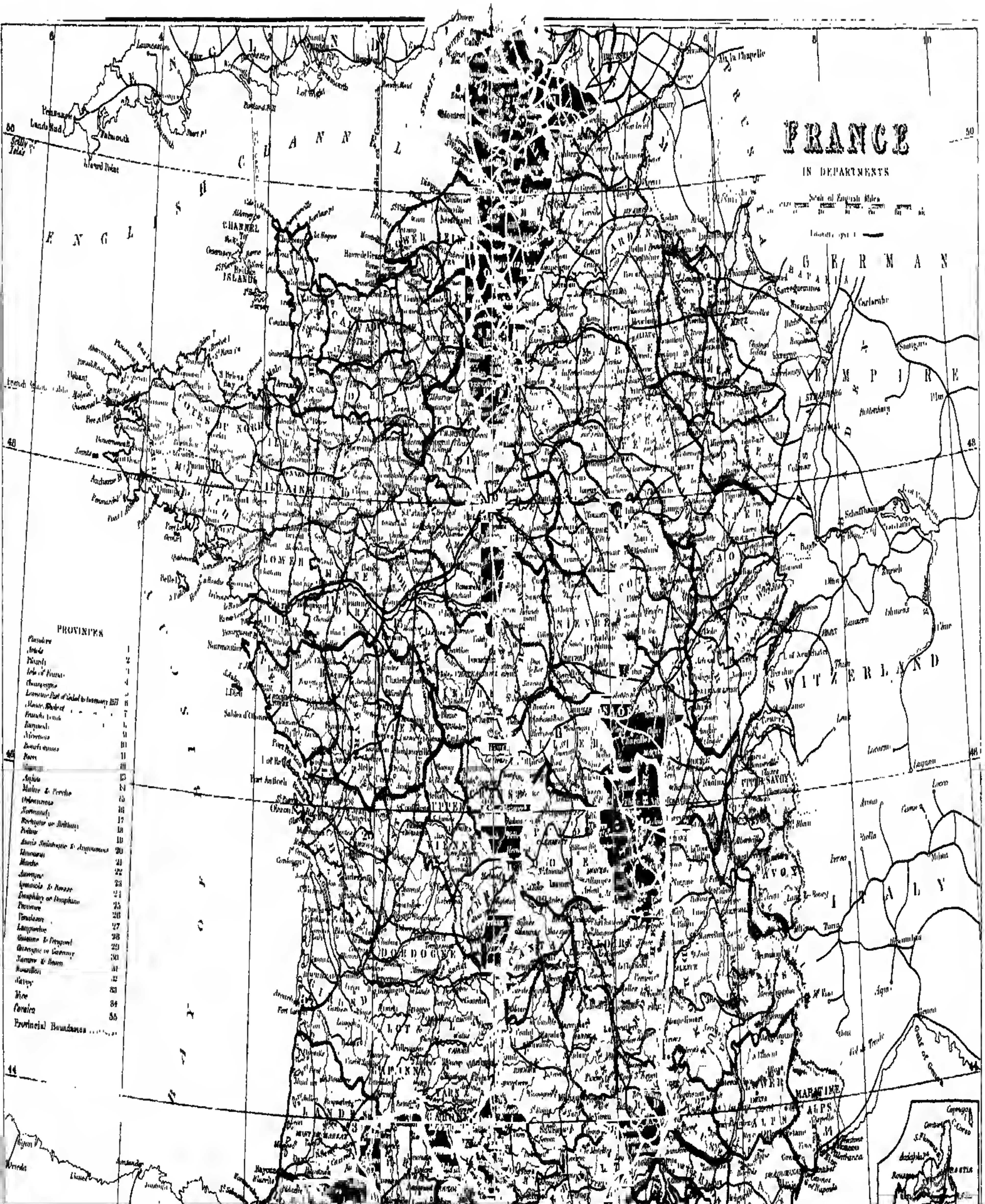


Fig. 49

Defence of a Position

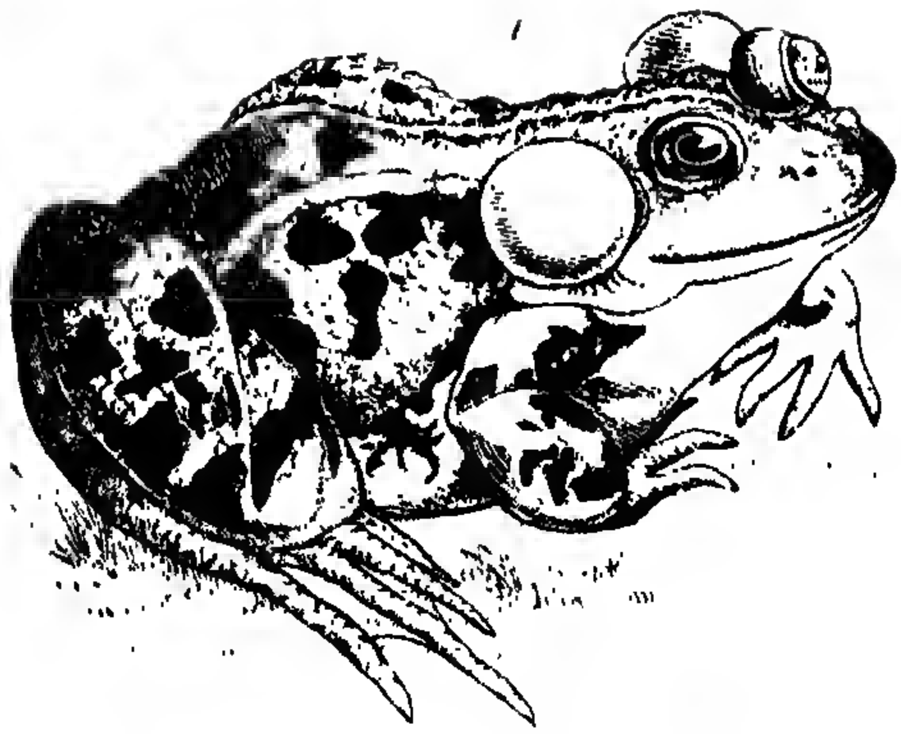




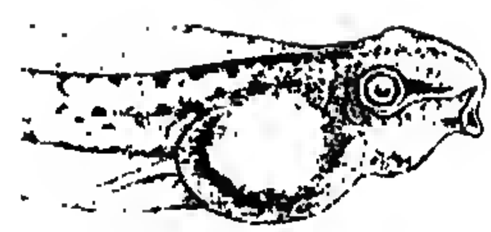
WILLIAM MACKENZIE, LONDON, EDINBURGH & GLASGOW

F R G S.

1

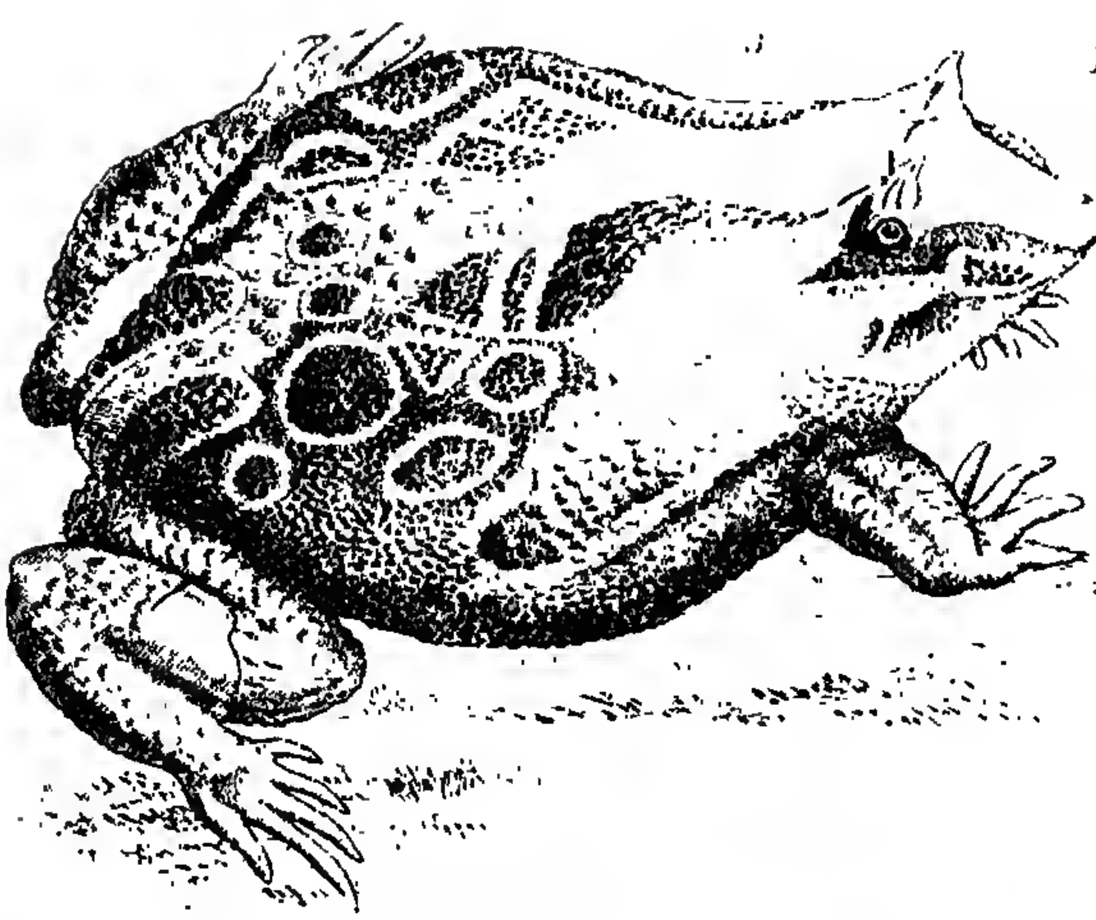


Rana esculenta . . Edible Frog



Tadpole of Rana esculenta

3



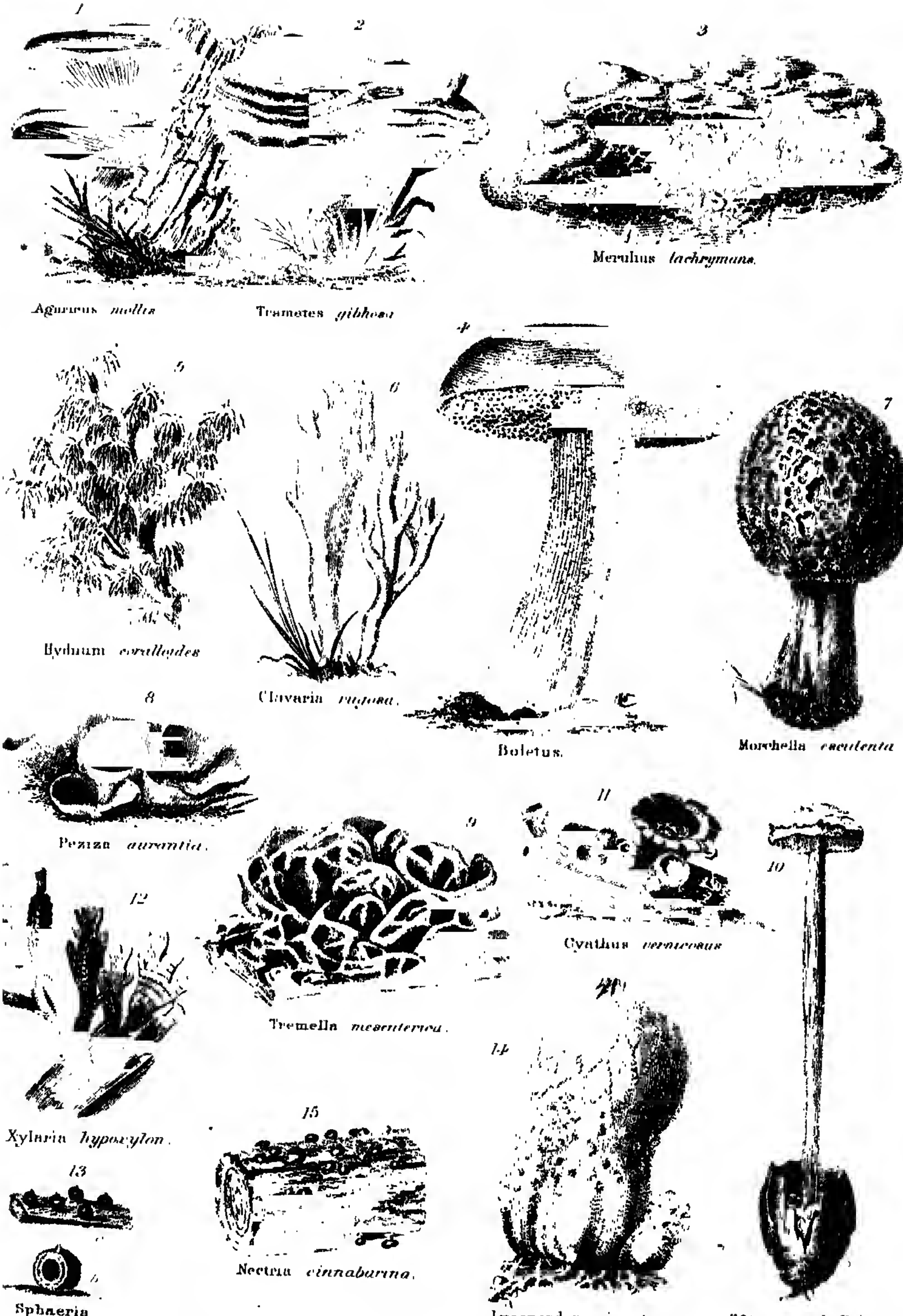
Ceratophrys cornutus. Horned Frog.

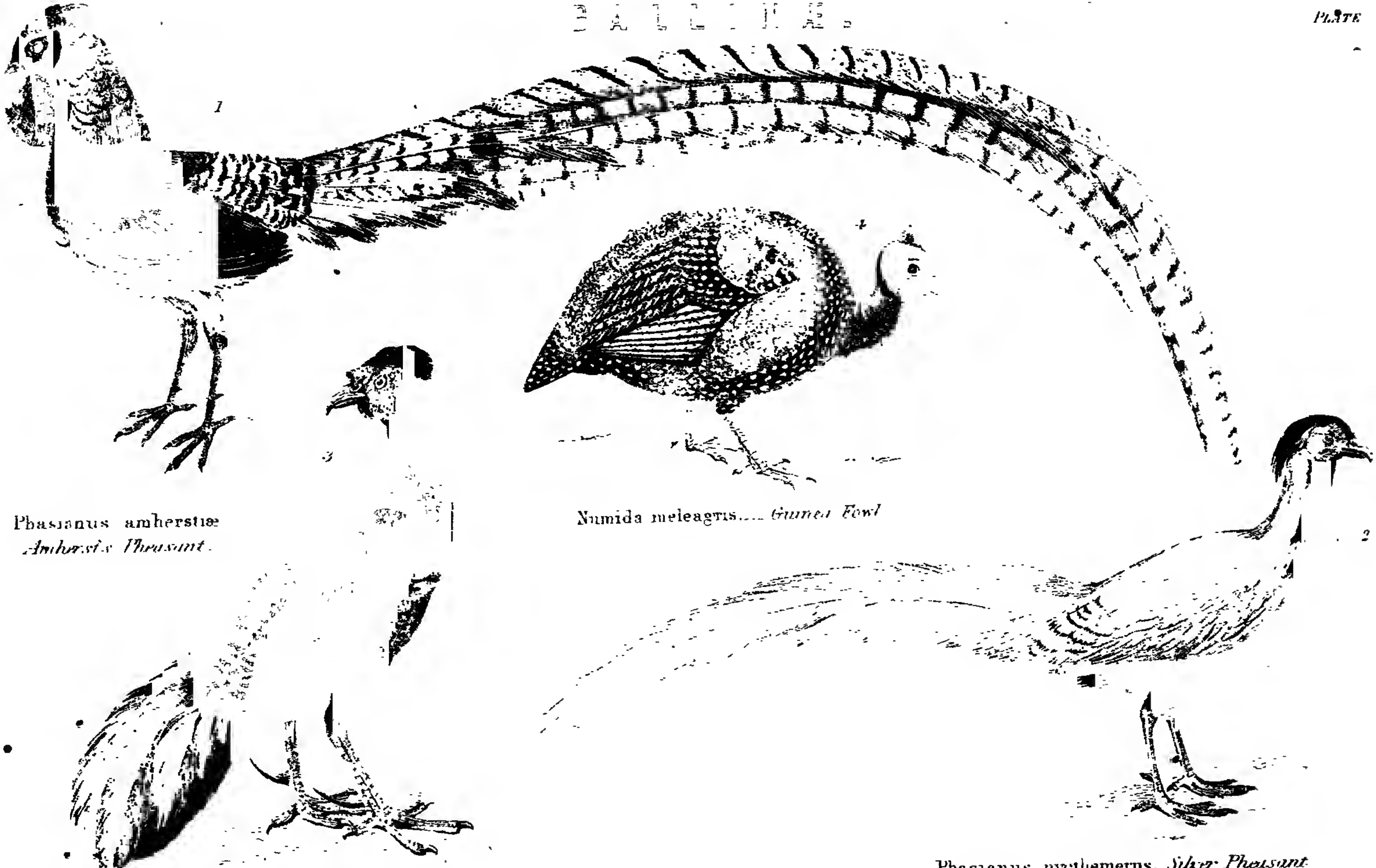
4

Tadpoles of Hyla vulgaris

Hyla vulgaris Tree Frog

FUNGUS.


1
2
3
Agaricus mollis
Trametes gibbosa
Merulius lachrymans.
4
5
6
7
Hydnum coralloides
Clavaria rugosa.
Boletus.
Morchella esculenta
8
Peziza aurantia.
9
11
10
12
Cyathus vernicosus
Tremella mesenterica.
14
Xylaria hypoxylon.
15
13
Sphaeria
Nectria cinnabarina.
Lycoperdon giganteum.
Batarrea phalloides.



Phasianus amherstiæ
Amherst's Pheasant.

Numida meleagris.... *Guinea Fowl*

Phasianus nycthemerus. *Silver Pheasant.*

Euplocamus ignitus... *Fire-backed Pheasant*

5

Megapodius freycineti *Freycinet's Mound Bird*

7

Crax alector *Curassow.*

8

Perdix rubra. *Red legged Partridge*

6

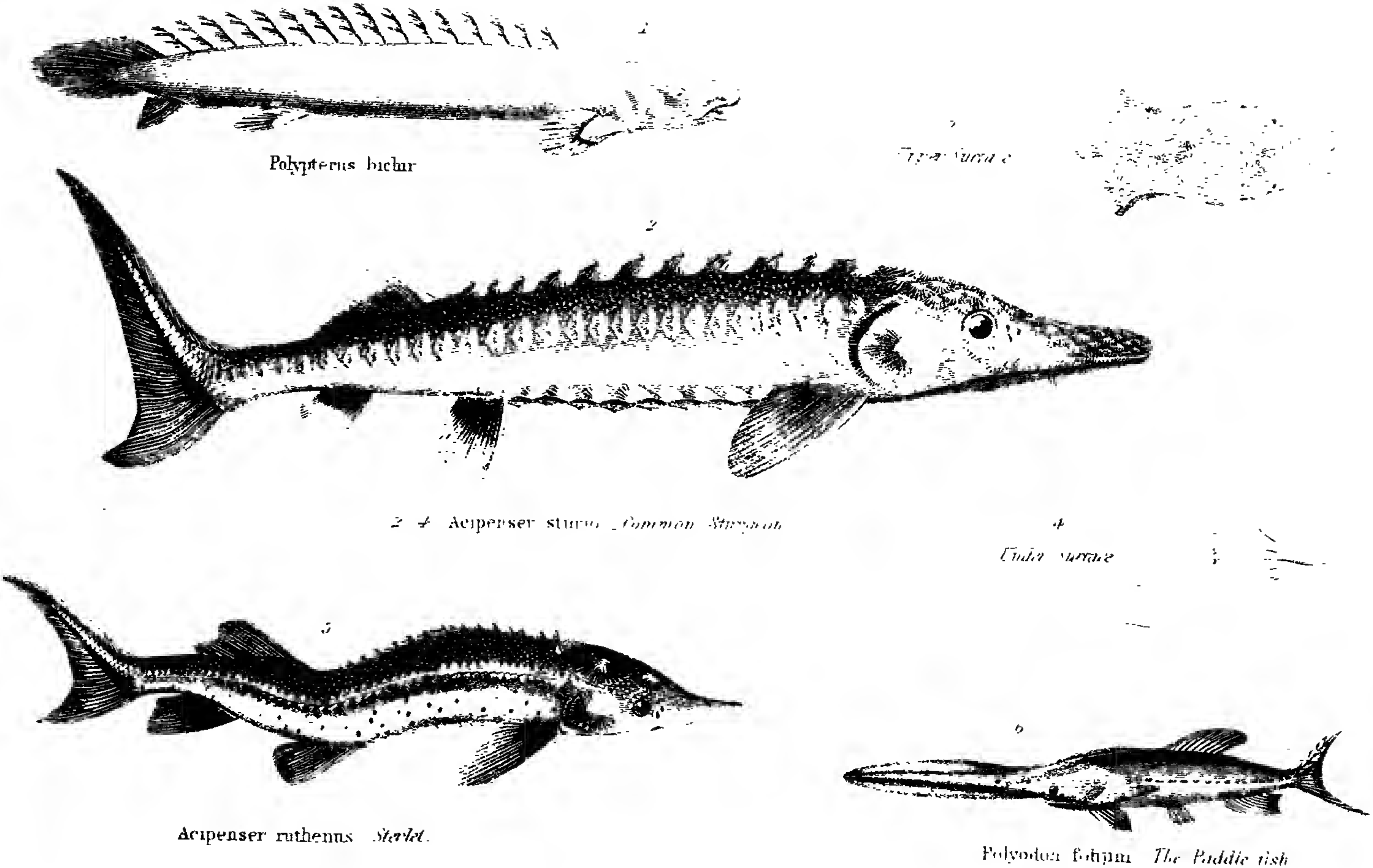
Talegalla lathami *Brush Turkey.*

9

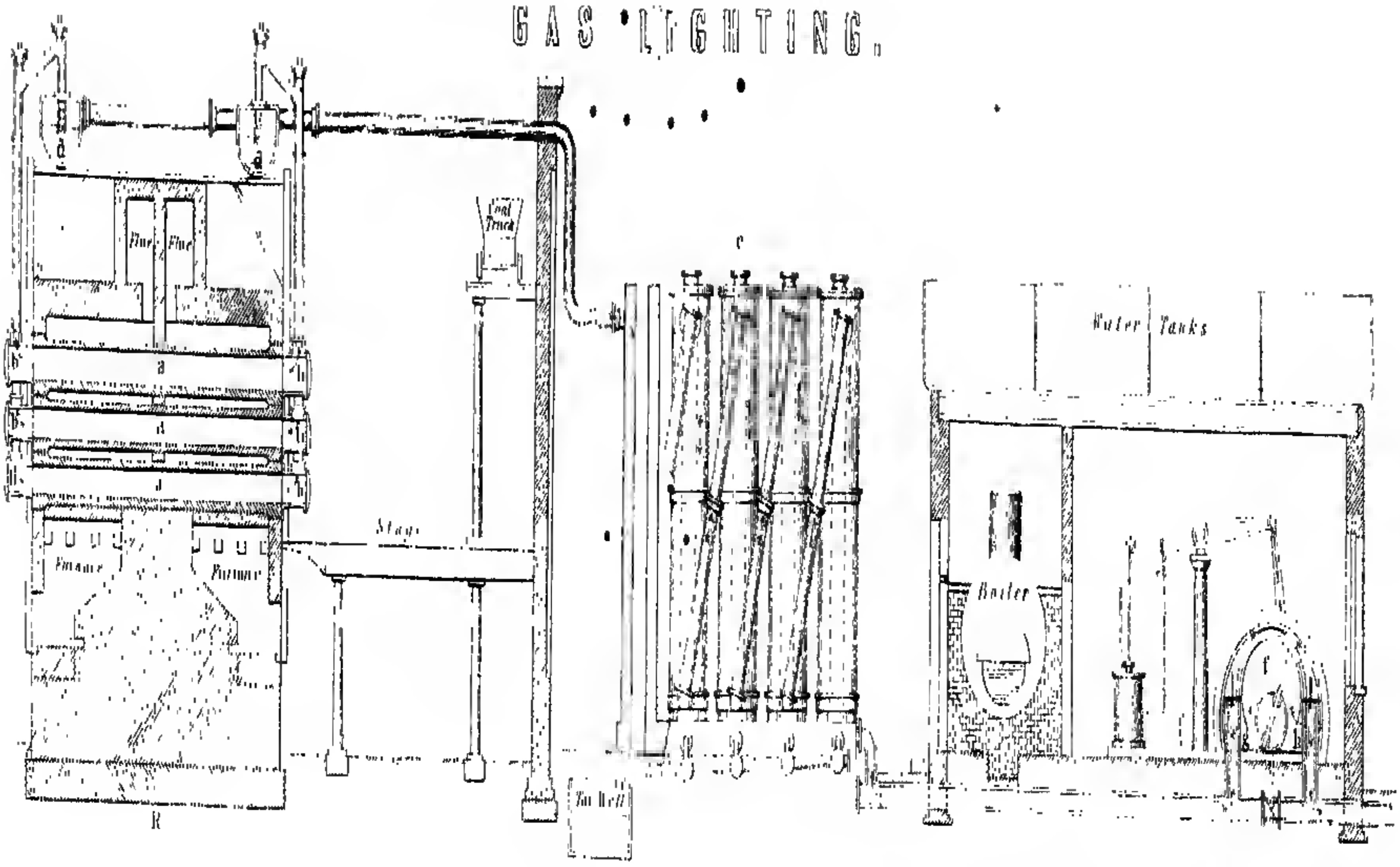
Rollulus cristatus *Crowned Partridge*

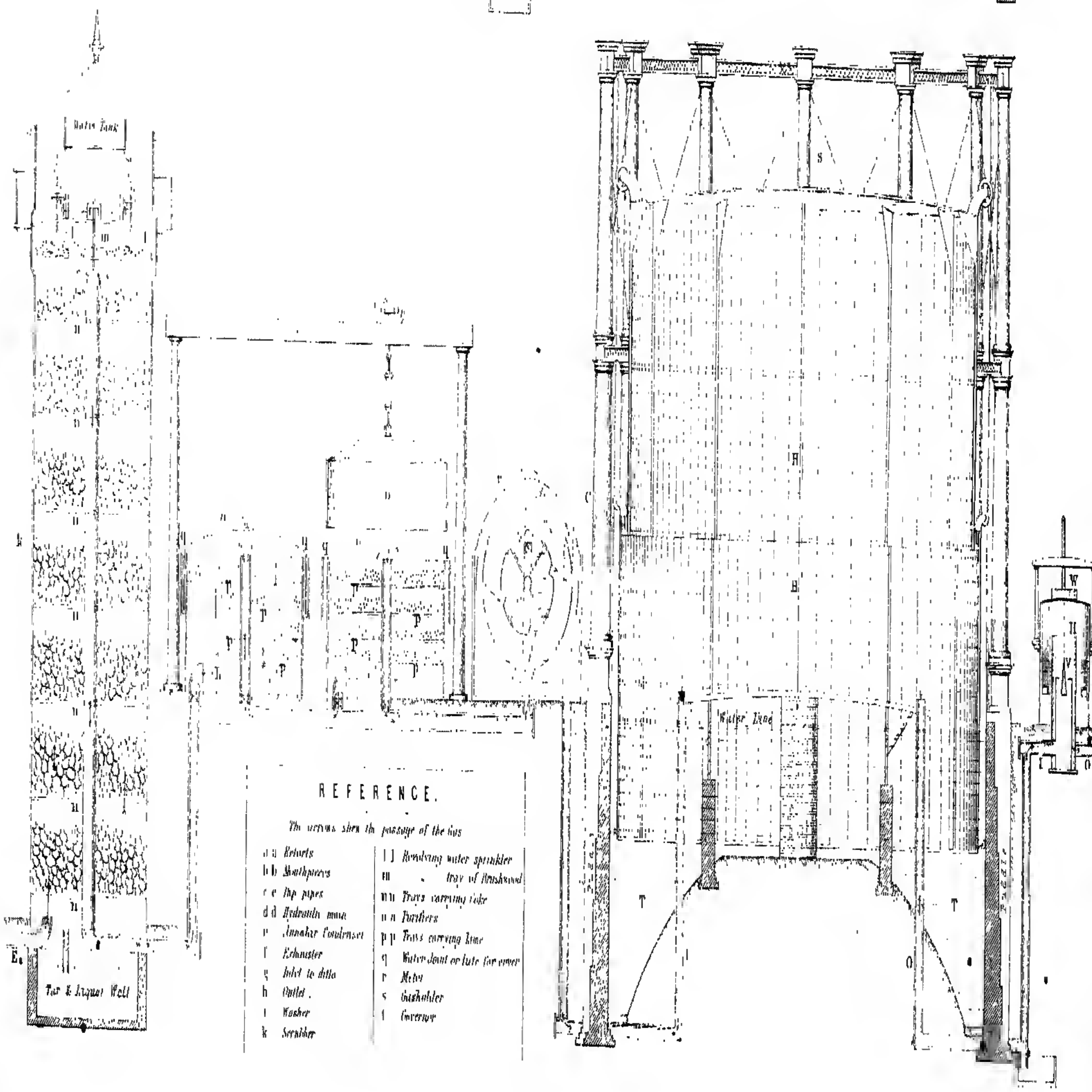
10

Chionis necrophaga *White Sheathbill*


Polypterus bichir
2 4 Acipenser sturio Common Sturgeon
Acipenser ruthenus Sterlet.
Polyodon folium The Paddle fish

GAS LIGHTING.





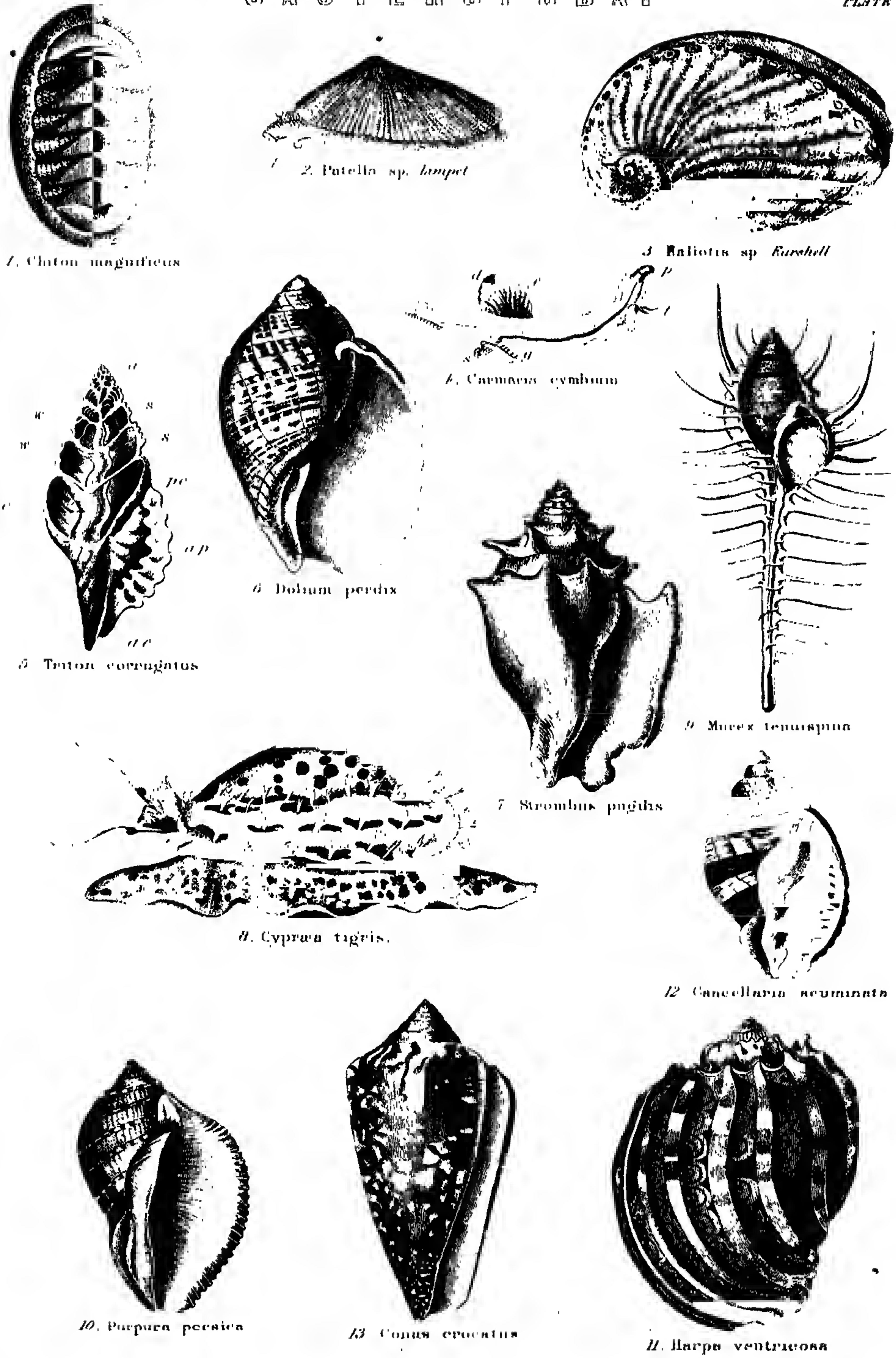
REFERENCE.

The arrows shew the passage of the Gas

a a *Retorts*	l l *Revolving water sprinkler*
b b *Mouthpieces*	m " *tray of Brushwood*
c c *Dip pipes*	n n *Trays carrying coke*
d d *Hydraulic main*	o o *Purifiers*
e *Annular Condenser*	p p *Trays carrying lime*
f *Exhauster*	q *Water Joint or lute for cover*
g *Inlet to ditto*	r *Meter*
h *Outlet.*	s *Gasholder*
i *Washer*	t *Governor*
k *Scrubber*	

GASTEROPODA.

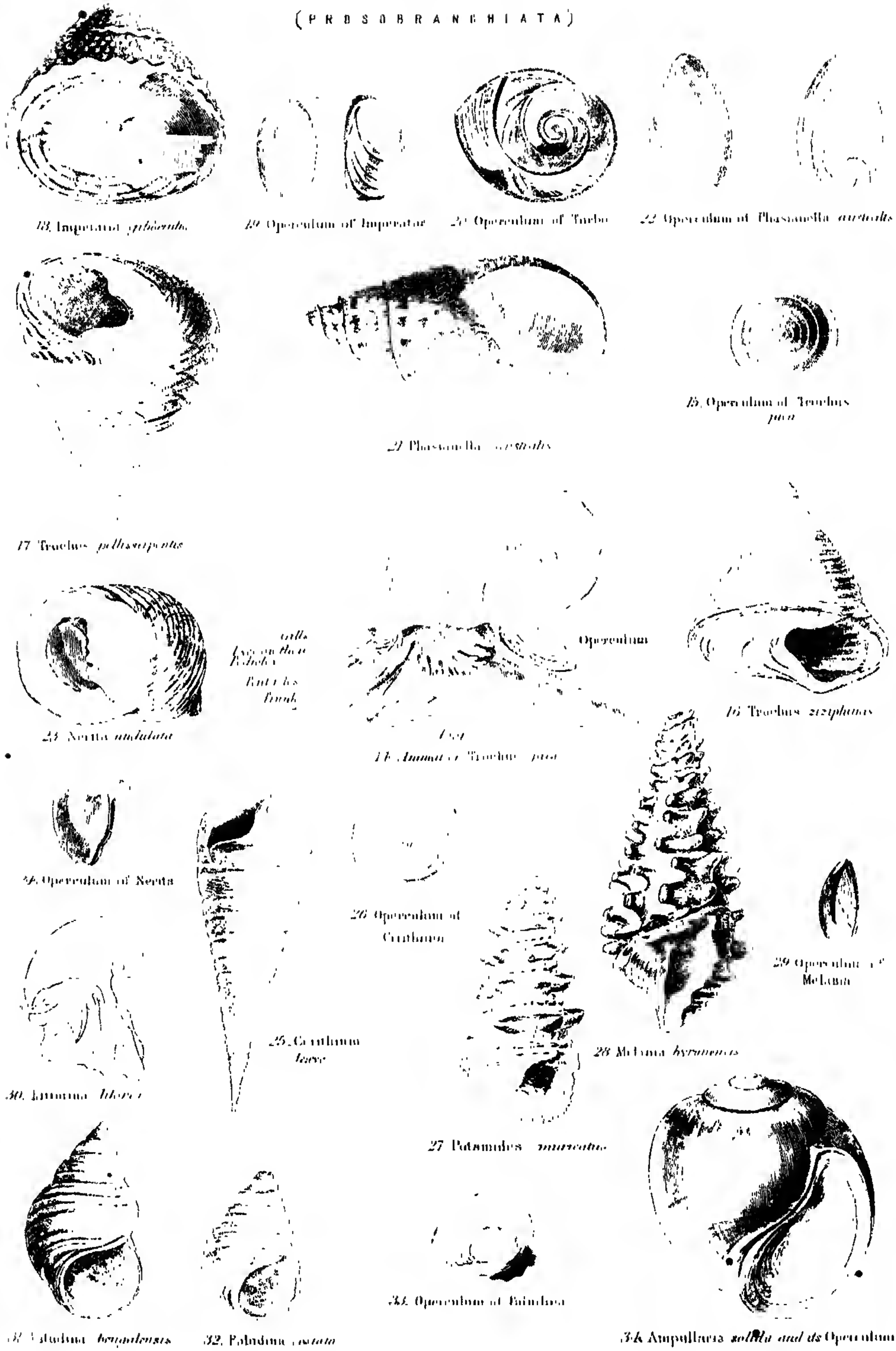
PLATE I.

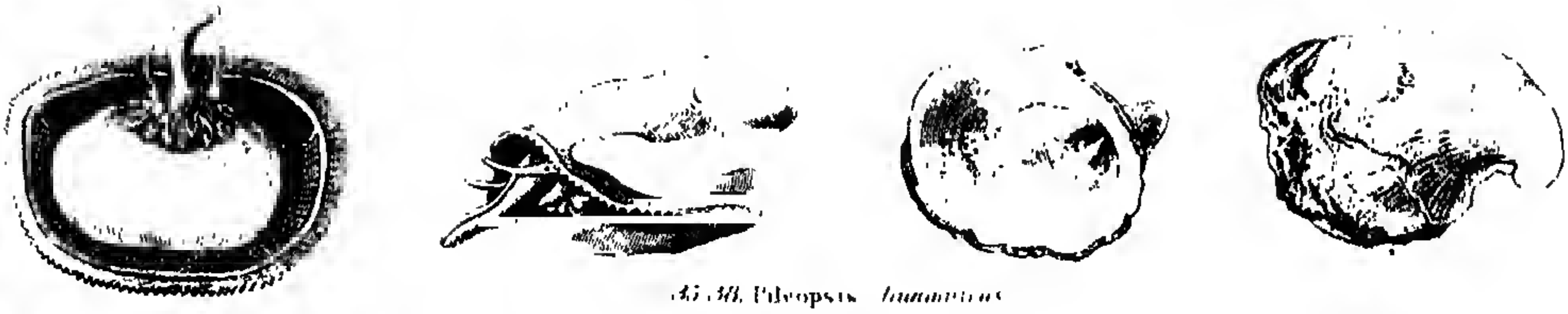


1. Chiton magnificus
2. Patella sp. *limpet*
3. Haliotis sp. *Earshell*
4. Carinaria cymbium
5. Triton corrugatus
6. Dolium perdix
7. Strombus pugilis
8. Cypræa tigris.
9. Murex tenuispina
10. Purpura persica
11. Harpa ventricosa
12. Cancellaria acuminata
13. Conus crocatus

GASTEROPODA. PLATE 2.

(PROSOBRANCHIATA)





35-38. Pileopsis hungaricus

39-40. Hipponyx mitrula

44-45. Amalthea australis

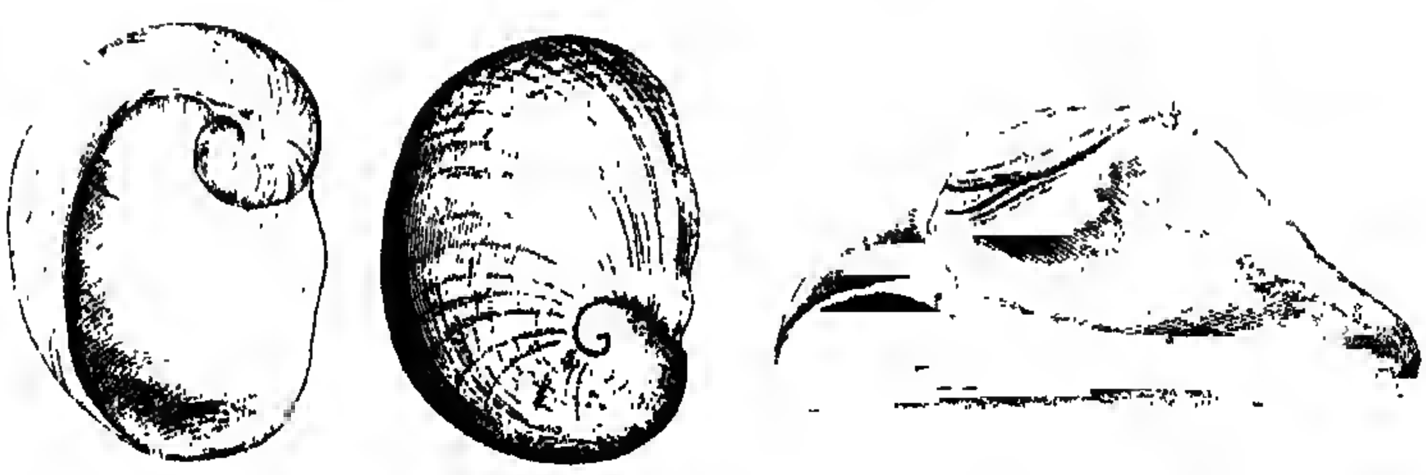
41-43. Hipponyx cornucopiae

46-47. Crepidula porcellana

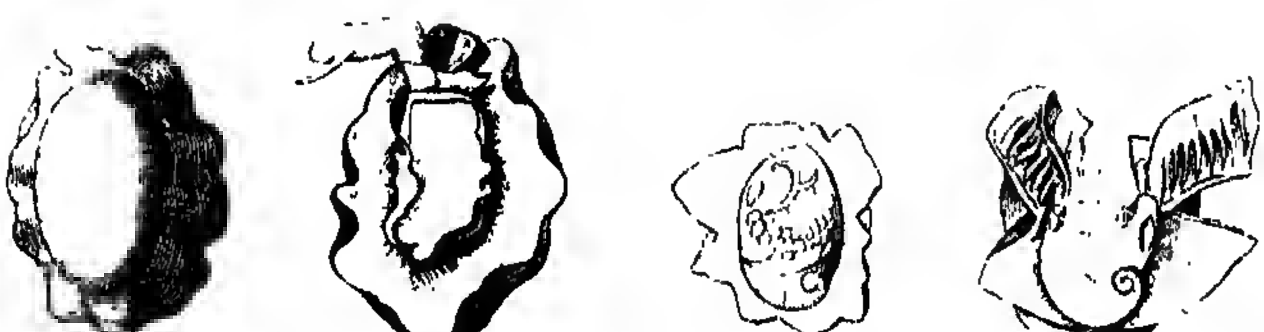
48-49. Calyptraea equestris

50. Crucibulum auriculatum

51. Natica millepunctata and its operculum

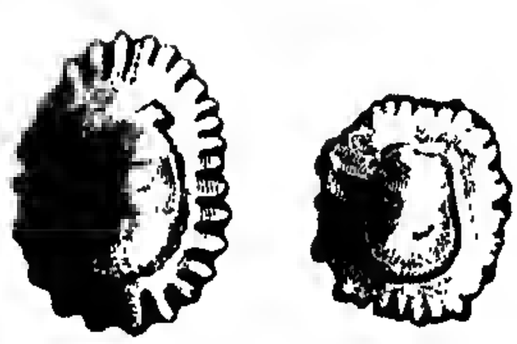


52-54. Sigaretus haliotoides

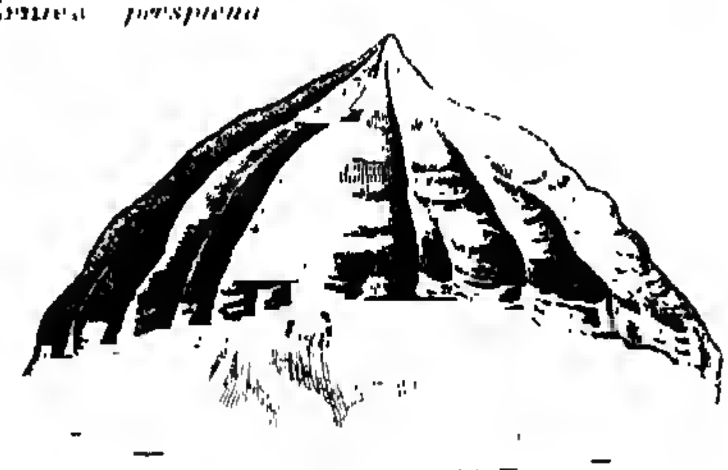


55-58. Ermea perspicua

59. Cornocella mara.



60-61. Siphonaria radiata.



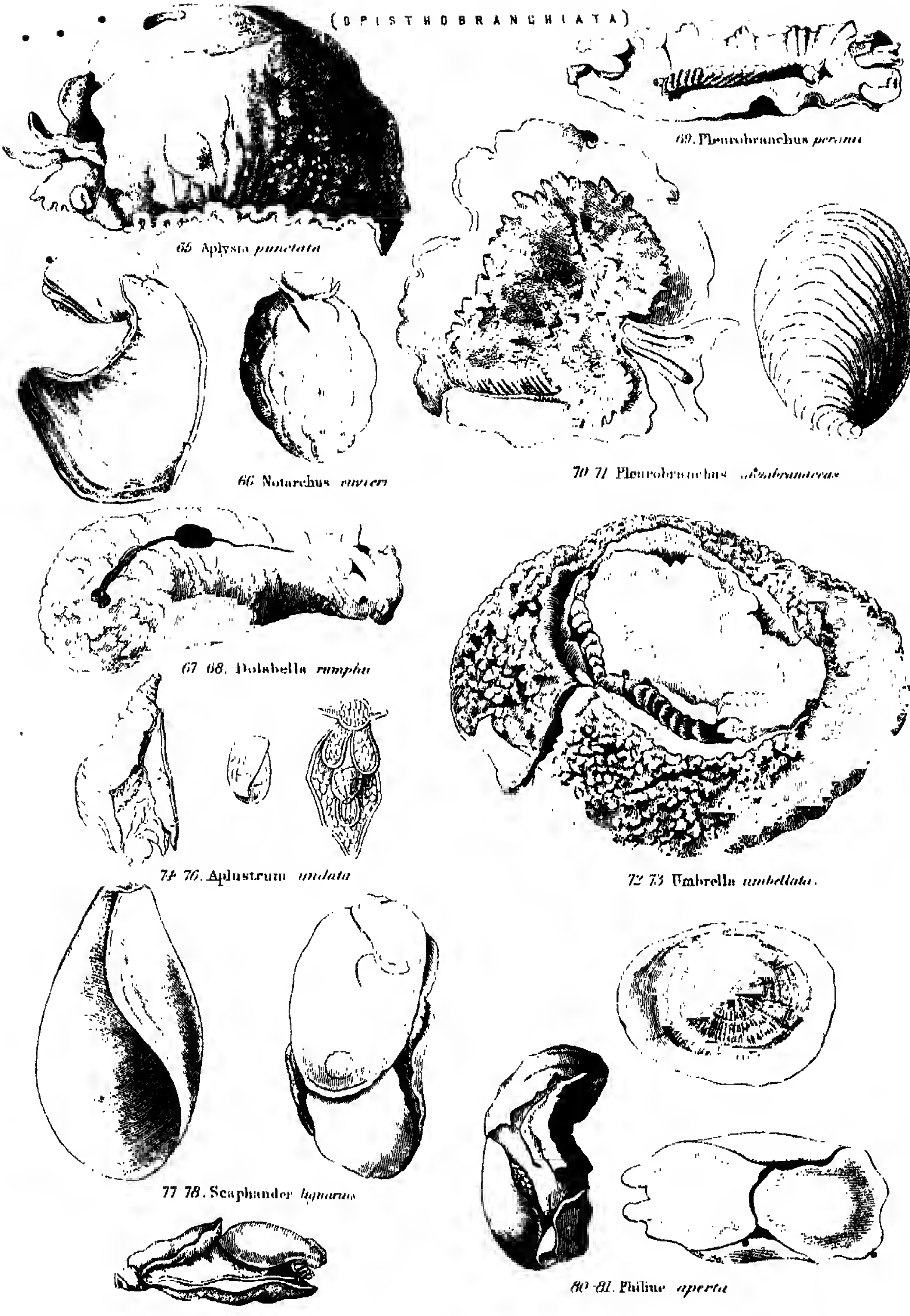
62. Siphonaria grandis

63-64. Gadinia afra

GASTEROPODA.

(OPISTHOBRANCHIATA)

PLATE 4



65 Aplysia *punctata*

66 Notarchus *cuvieri*

67 68. Dolabella *rumphii*

69. Pleurobranchus *peronii*

70 71 Pleurobranchus *[illegible]*

72 73 Umbrella *umbellata*.

74 76. Aplustrum *undata*

77 78. Scaphander *lignarius*

79. Acera *carnosa*.

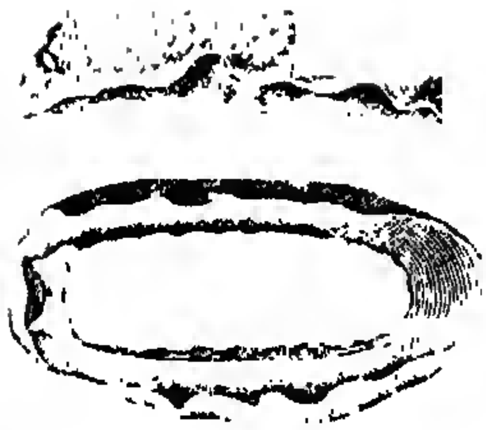
80 81. Philine *aperta*

GASTEROPODA

(O THOBRANCHIATA)

89. Goniodoris nodosa

82 Doris limbata

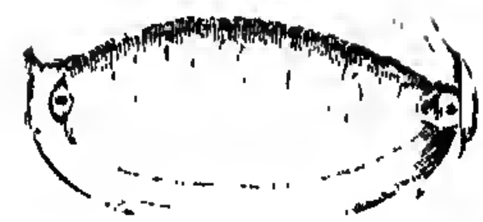


84 85 Onchidoris leachii

90. Ceratosoma trilobata

91 Hexabranchus lacinulatus

83. Doris tuberculata



92 Polycera cornuta

94 Idalia quadricornis

93 Thecacera quadricornis

95 Tethys leporina

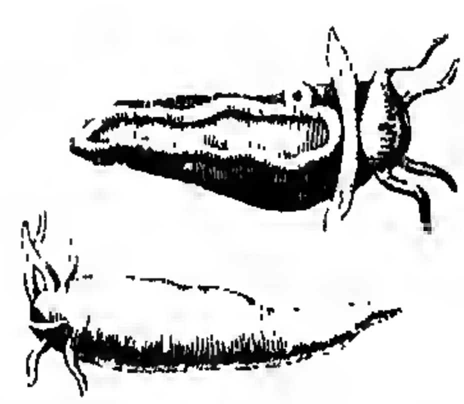
98 Eolis Flabellina cuvieri

99. Eolis

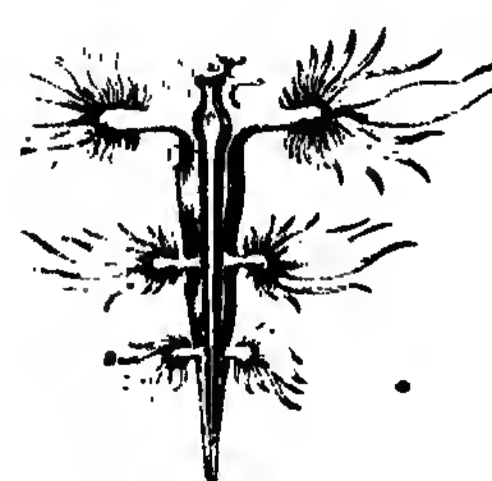
102 Glaucus elfortii

96. Tritonia hombergii

97. Scyllaea pelagica



100 101. Eolis (Tergipes) lamarckii

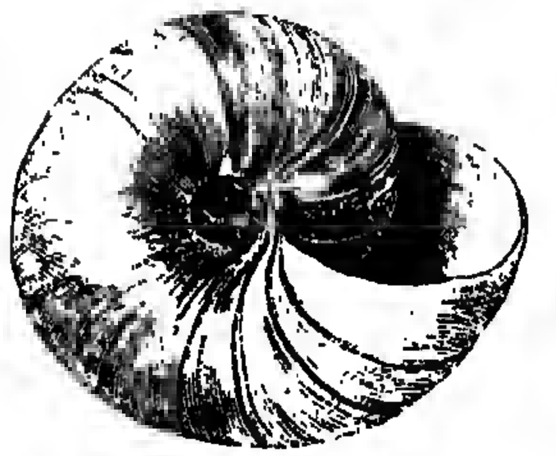


103 Glaucus atlanticus

GASTEROPODA.

(PULMONIFERA)

104. Helix *hæmastoma*



105. Helix *algira*

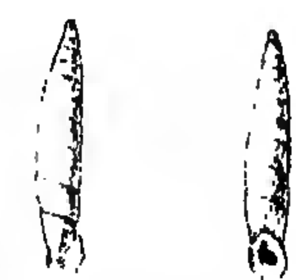
106. Helix *lapicida*.

107. Helix *epistylium*

109. Achatina *virginea*

111. Pupa *mumia*

110. Bulimus *ovatus*



112. Clausilia *cærulea*

116. Physa *rivalis*

115. Testacella *maugei*

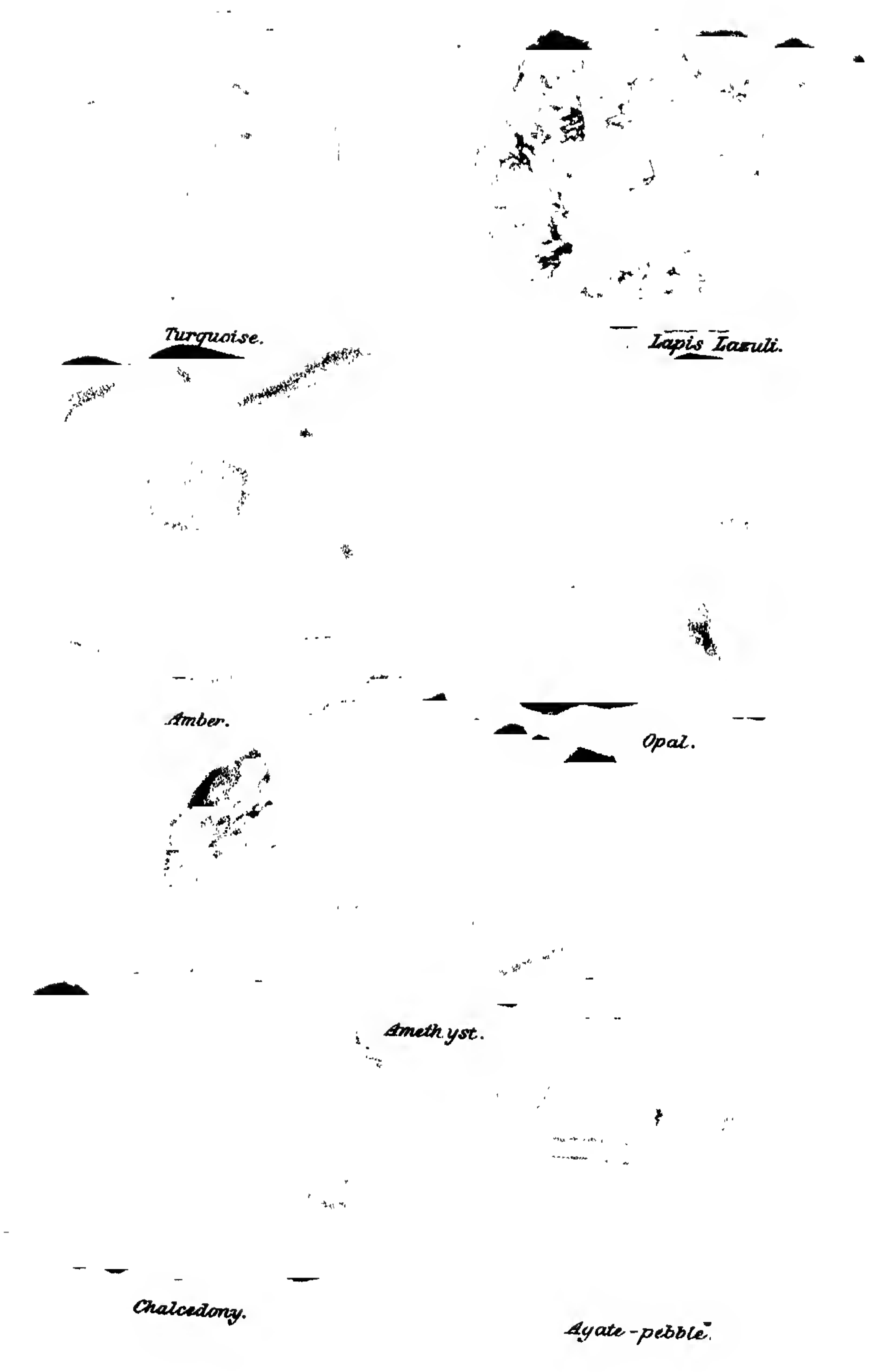
108. Helix *naticoides*

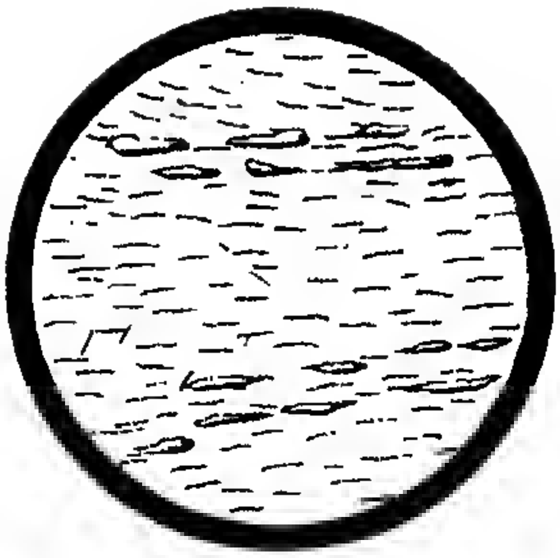
114. Arion *ater*

113. Limax *flavus*

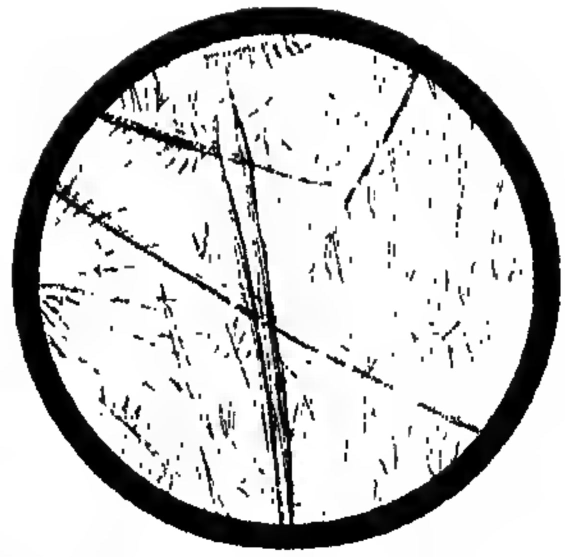

Brazil Diamond.
Sand
Rubies.
Sapphire
Diamond Sand.
Rubies.
Sand with Sapphires
Emerald.
Topaz.
Garnet.

GEMS.

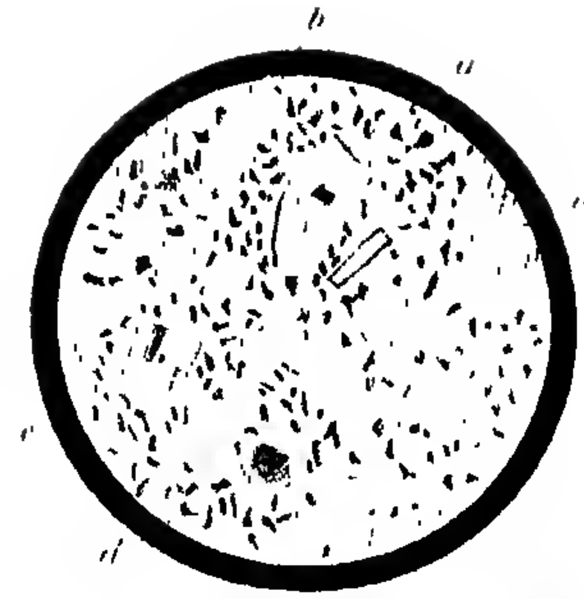

Turquoise.
Lapis Lazuli.
Amber.
Opal.
Amethyst.
Chalcedony.
Agate-pebble.



1. Obsidian, with Microliths. × [illegible] inch

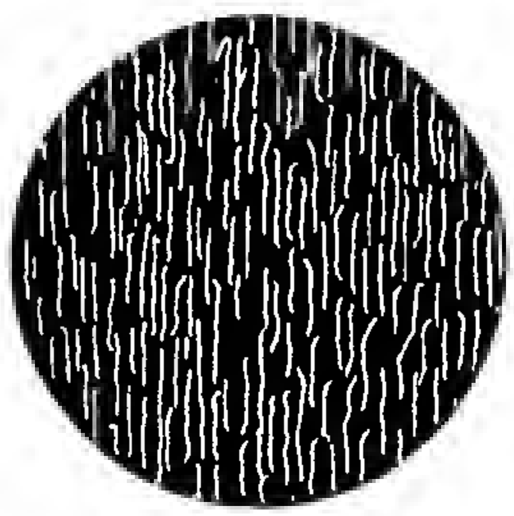


2. Pitchstone, Arran (Forbes) × 75



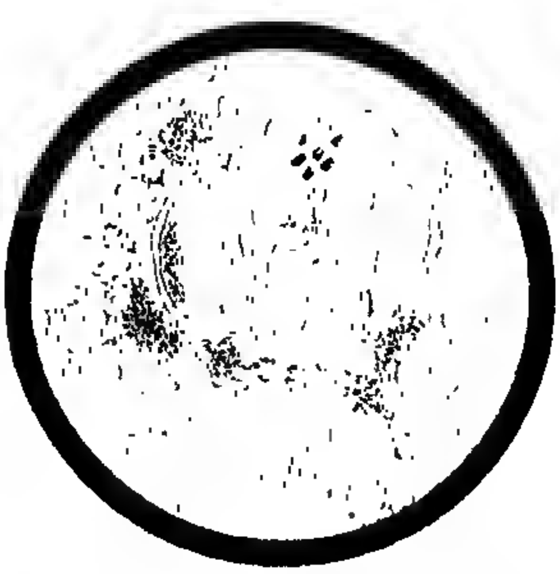
3. Basalt, Arthur's Seat, × 1 inch, a Augite b Plagioclase c Labradorite, d [illegible]

4. Granite, Aberdeen, × 1 inch a Quartz b Mica c Orthoclase



5. Slate, Llanberis × 100

6. Slate, Ffestiniog. (Forbes) × 200



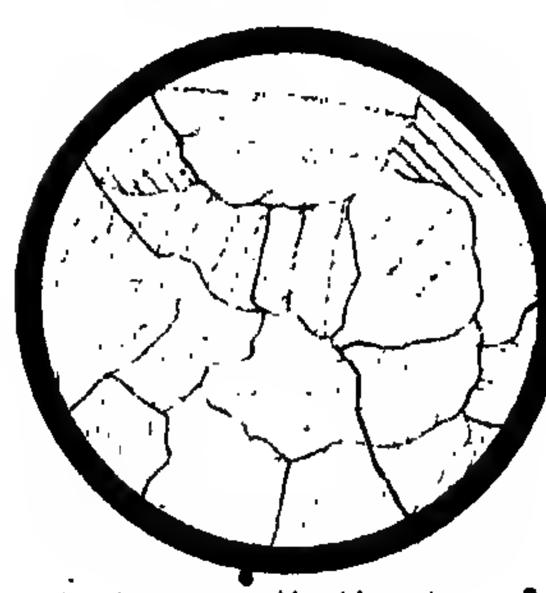
7. Chalk, Specton (Sorby) × 100

8. Oolite Forest Marble × 1 inch

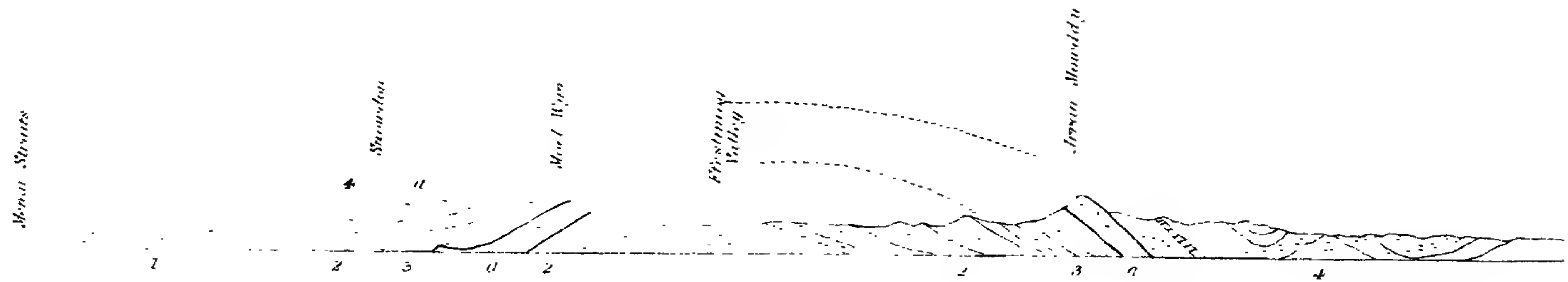
9. Magnesian Limestone (Sorby) × 50

10. Blazing Coal, × 1 inch, with spores

11. Mica Schist, Holyhead, × 1 inch a Mica b Quartz.

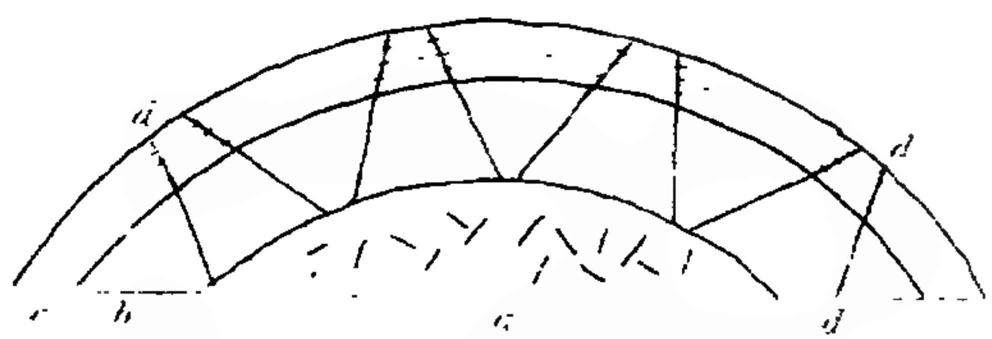


12. Statuary Marble, Carrara × 1 inch

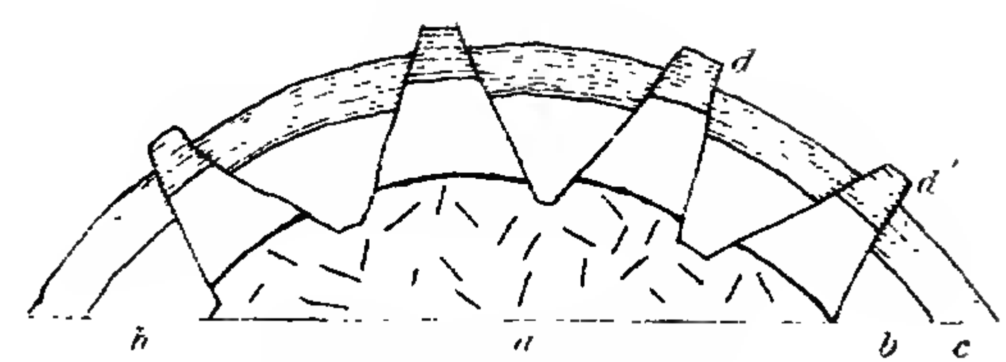


16. Section through Snowdon.

1 Arenig 2 Cambrian 3 Lower Silurian (Llandeilo) 4 Caradoc or Bala Beds. a Volcanic (Murchison).

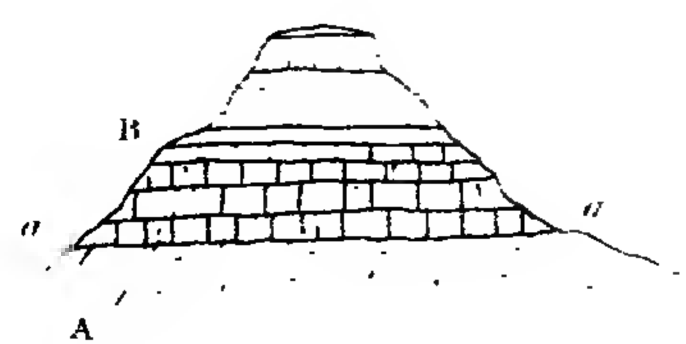


14. First Stage Development of Fractures



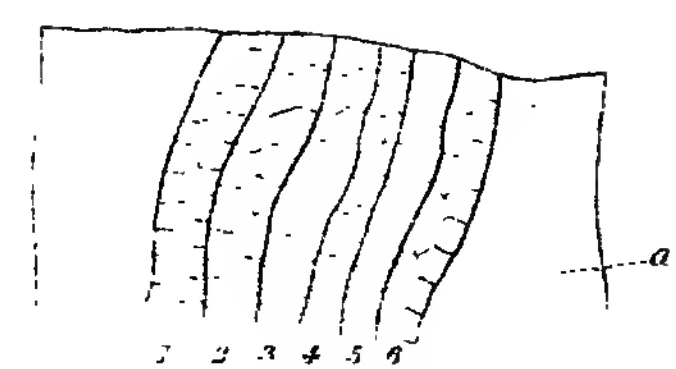
15. Second Stage Dislocation

Figs 14, 15 Diagrams of Faults a Extending rock b c Strata above d Fracture of Fault.



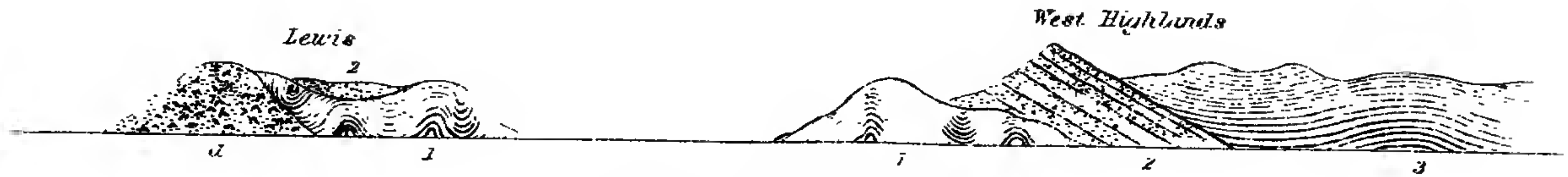
13. Section through Ingleborough.

A Silurian. B Carboniferous. a a Plateau of Erosion



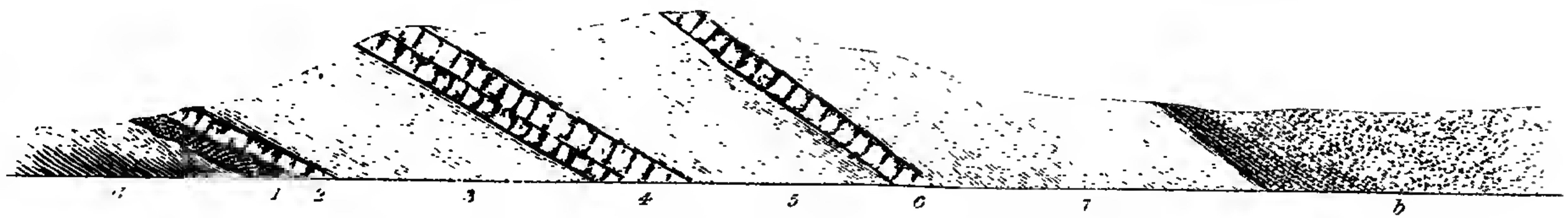
17. Copper Lode at Redruth, Cornwall.

enlarged at Six successive times a Granite



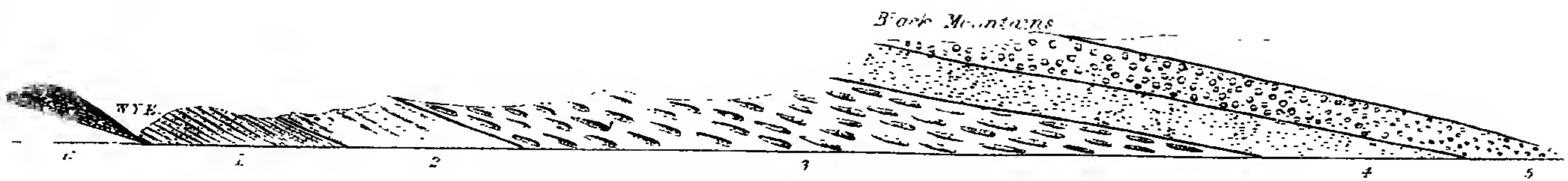
18. Diagram of Western Highlands

a Granite. 1 Archæan 2 Cambrian 3 Lower Silurian



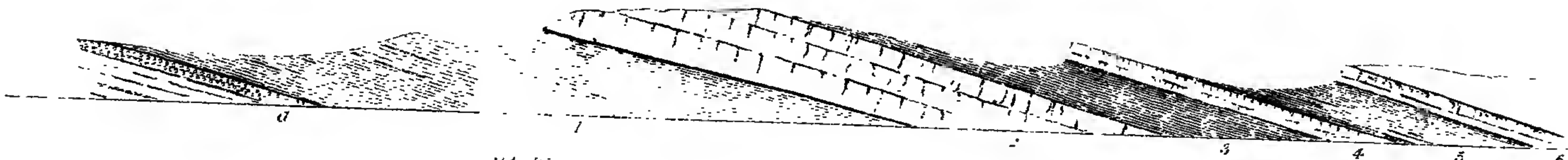
19 Diagram across Wenlock Edge. Salop. showing Upper Silurian Rocks (3550 feet)

a Caradoc or Bala Beds. 1 Upper Llandovery. 2 Woolhope Limestone. 3 Wenlock Shale. 4 Wenlock Limestone. 5 Lower Ludlow Shale. 6 Aymestry Limestone. 7 Upper Ludlow Shale. b Old Red Sandstone.



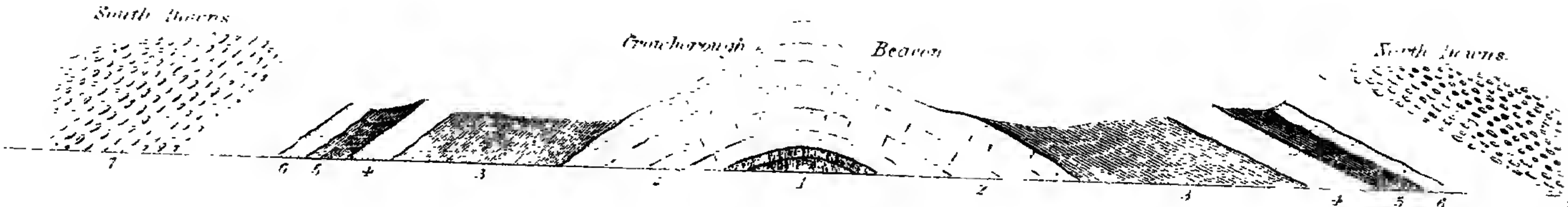
20 Diagram of Old Red Sandstone in Monmouthshire ([illegible] feet)

a Upper Ludlow. 1 Red Marls and Flags. 2 White Sandstone. 3 Marls Flagstones & Cornstones. 4 Chocolate Coloured Sandstone. 5 Conglomerate and Sandstone. b Carboniferous Limestone



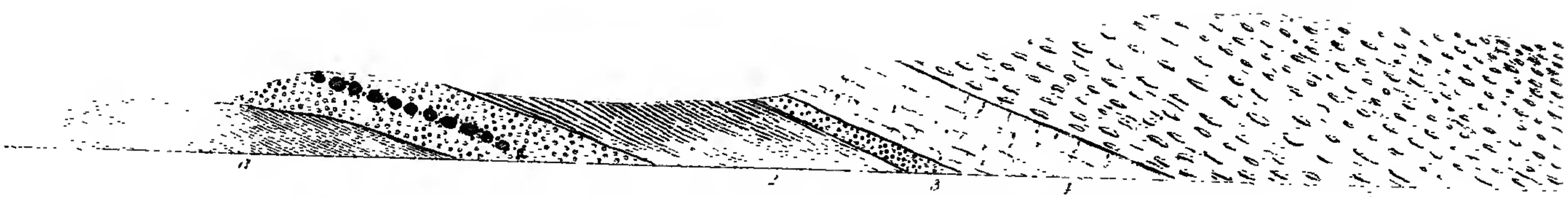
24. Diagram of Liassic and Oolitic Rocks in Oxfordshire.

a Rhætic 1 Lias 2 Lower Oolites 3 Kellaways Rock and Oxford Clay 4 Coralline Oolite 5 Kimmeridge Clay
6 Portland Sands and Stone 7 Wealden of Shotover



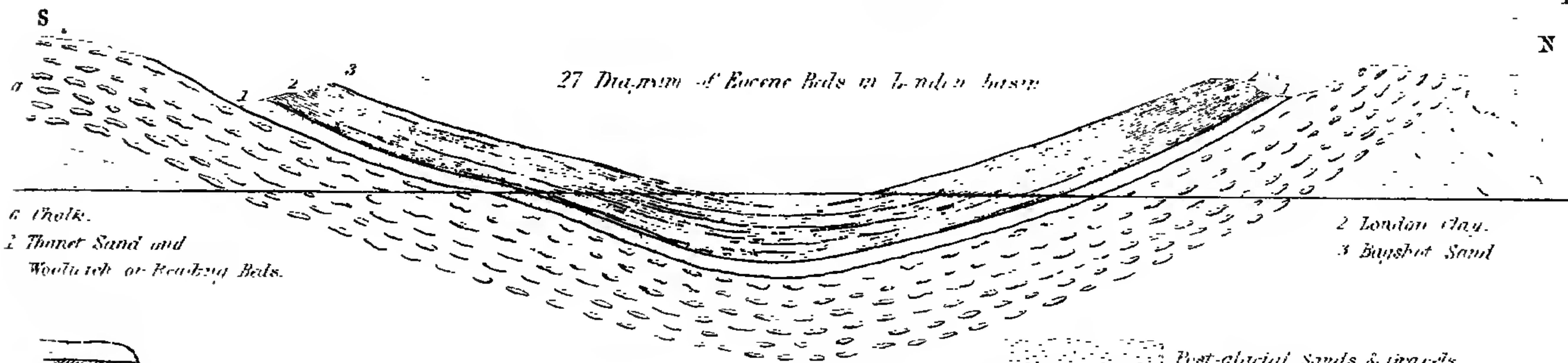
25 Diagram through Wealden area of Kent and Sussex

1 Purbeck Beds 2 Hastings Sands 3 Weald Clay 4 Lower Greensand (Neocomian) 5 Gault 6 Sandy Chalk Marl 7 Chalk

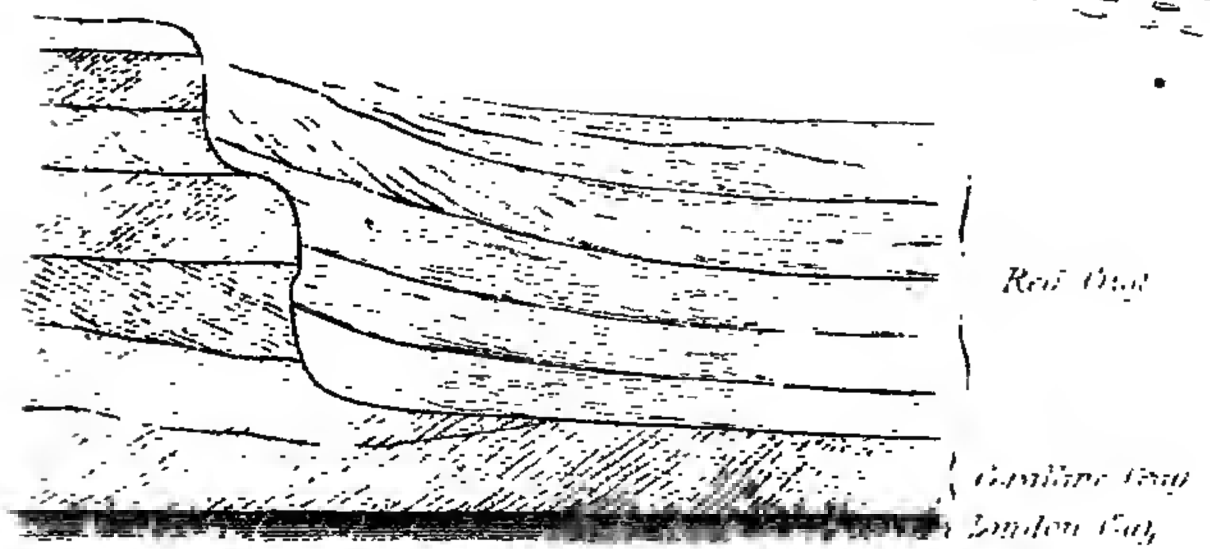


26 Diagram of Cretaceous Rocks in Cambridgeshire

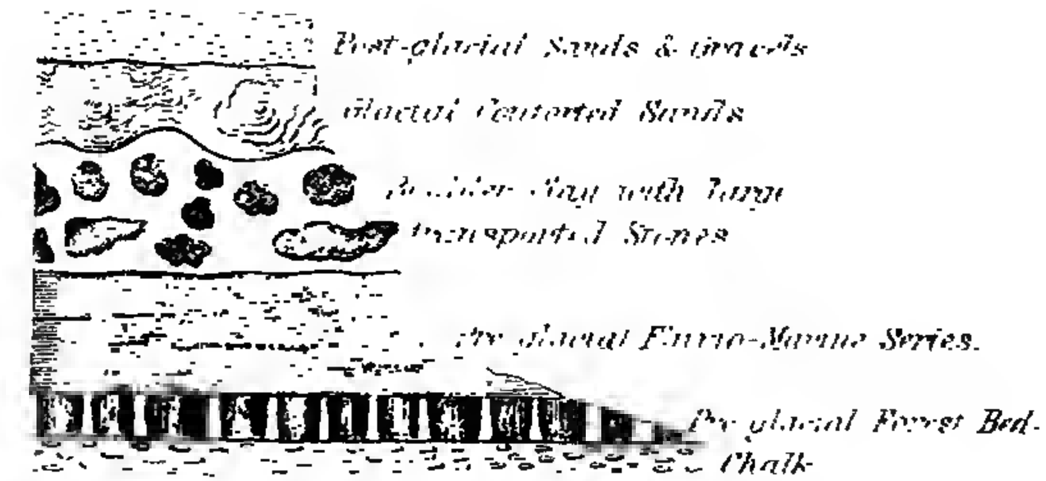
a Kimmeridge Clay 1 Lower Greensand 2 Gault 3 Chloritic Marl 4 Lower Chalk 5 Upper Chalk



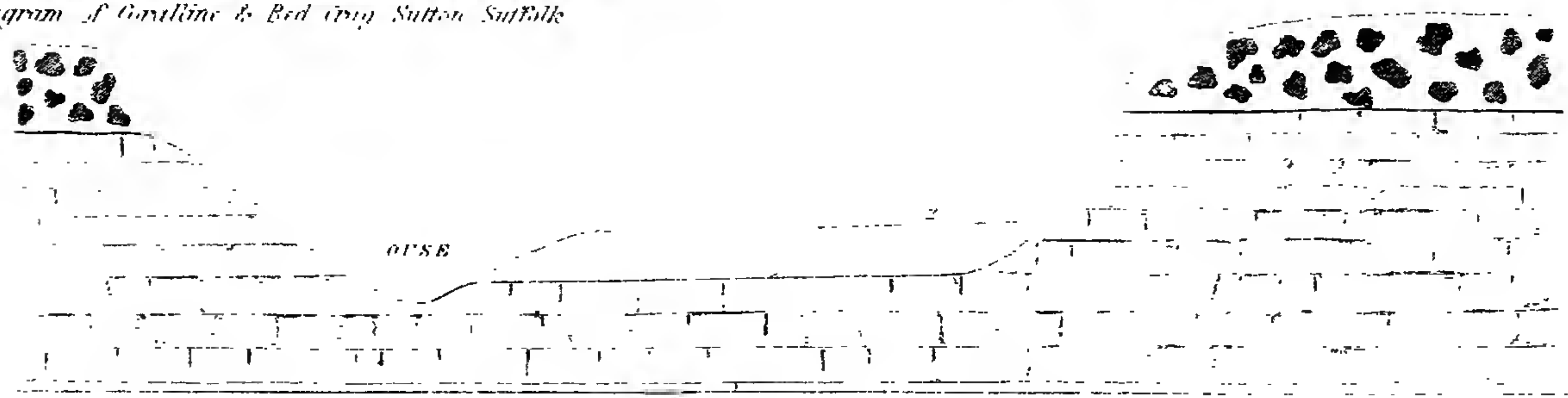
27 Diagram of Eocene Beds in London basin



28. Diagram of Coralline & Red Crag Sutton Suffolk

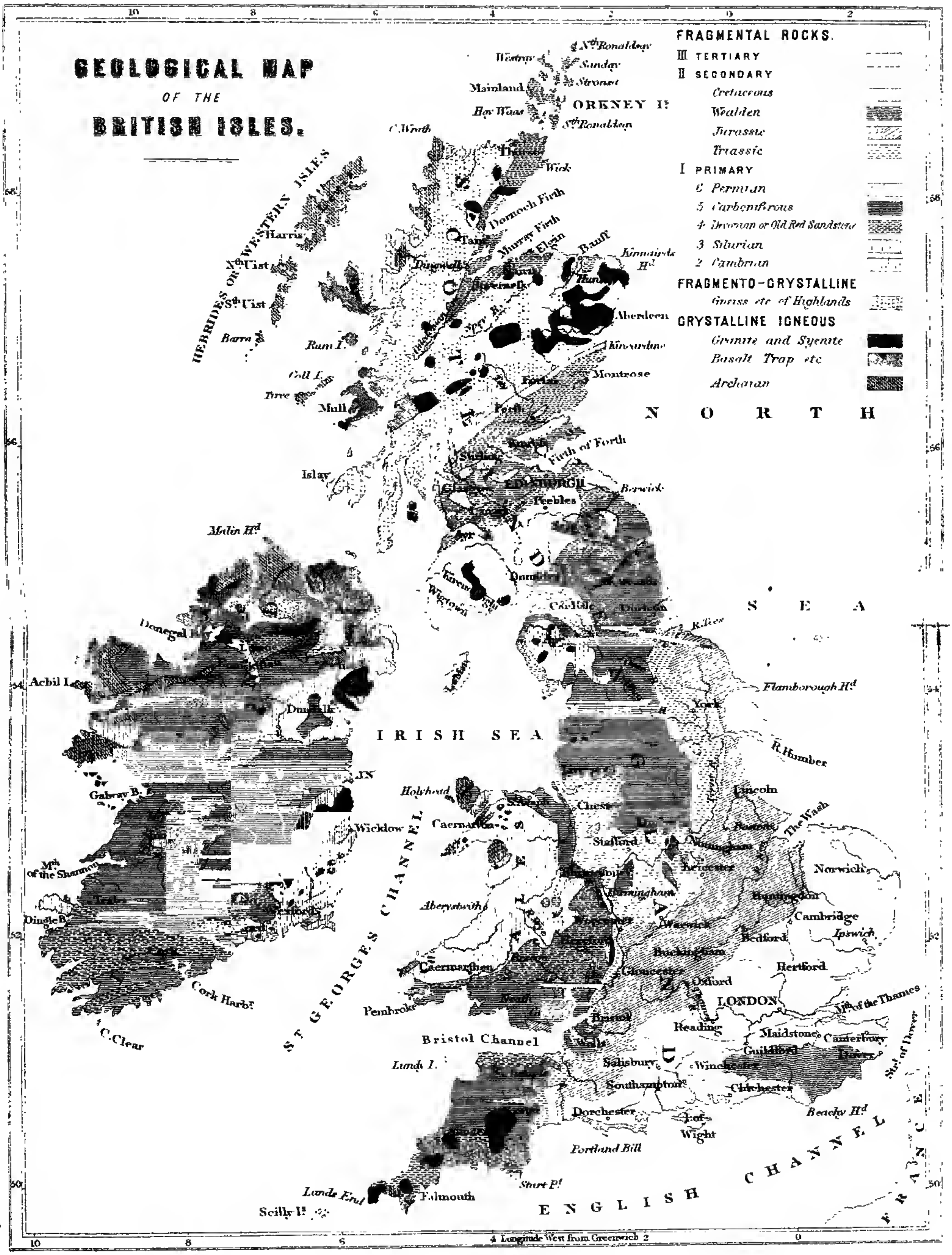


29 Diagram of Forest Bed of Norfolk.

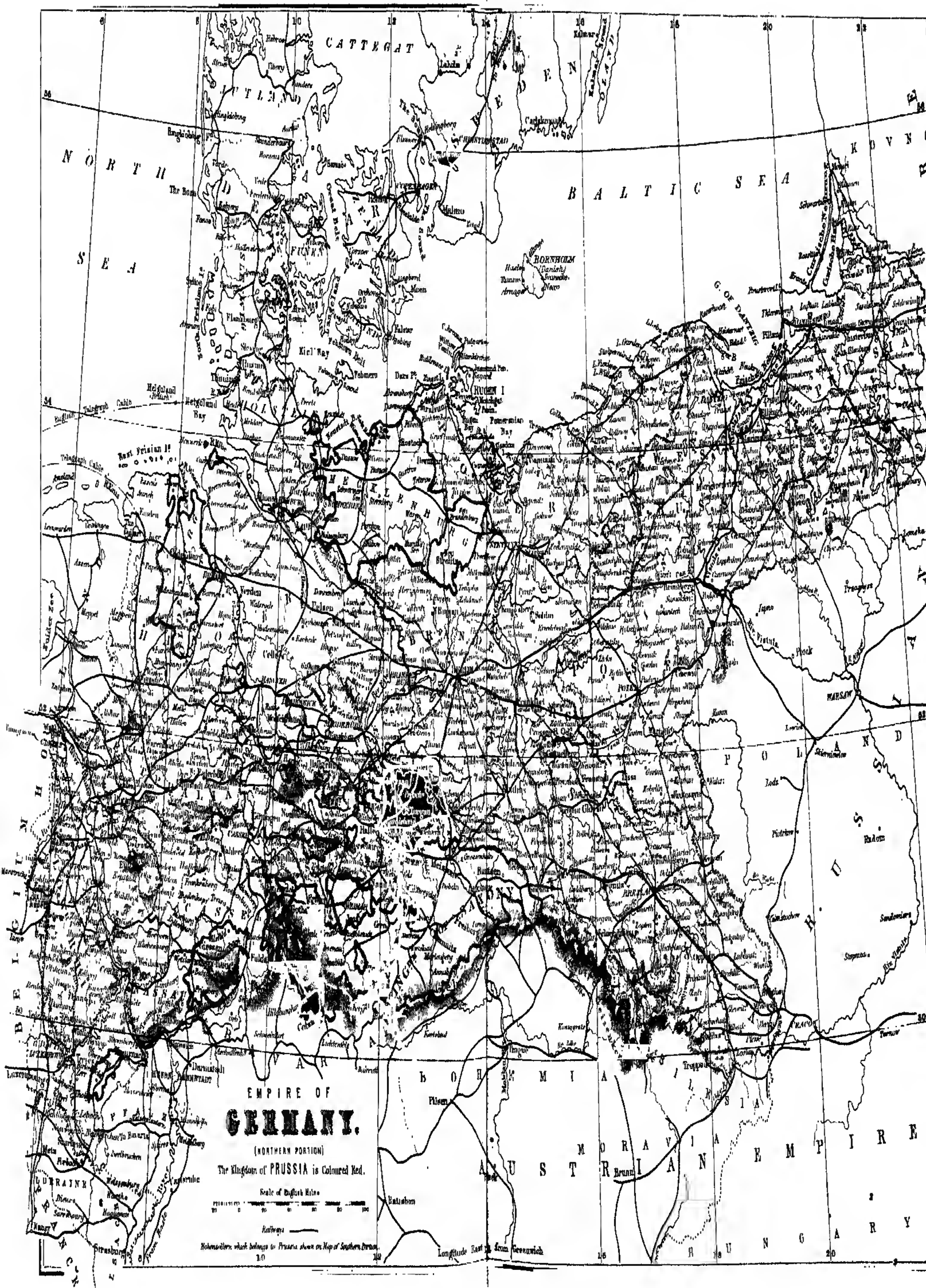


30. Diagram of Biddenham Gravel pit, Bedford

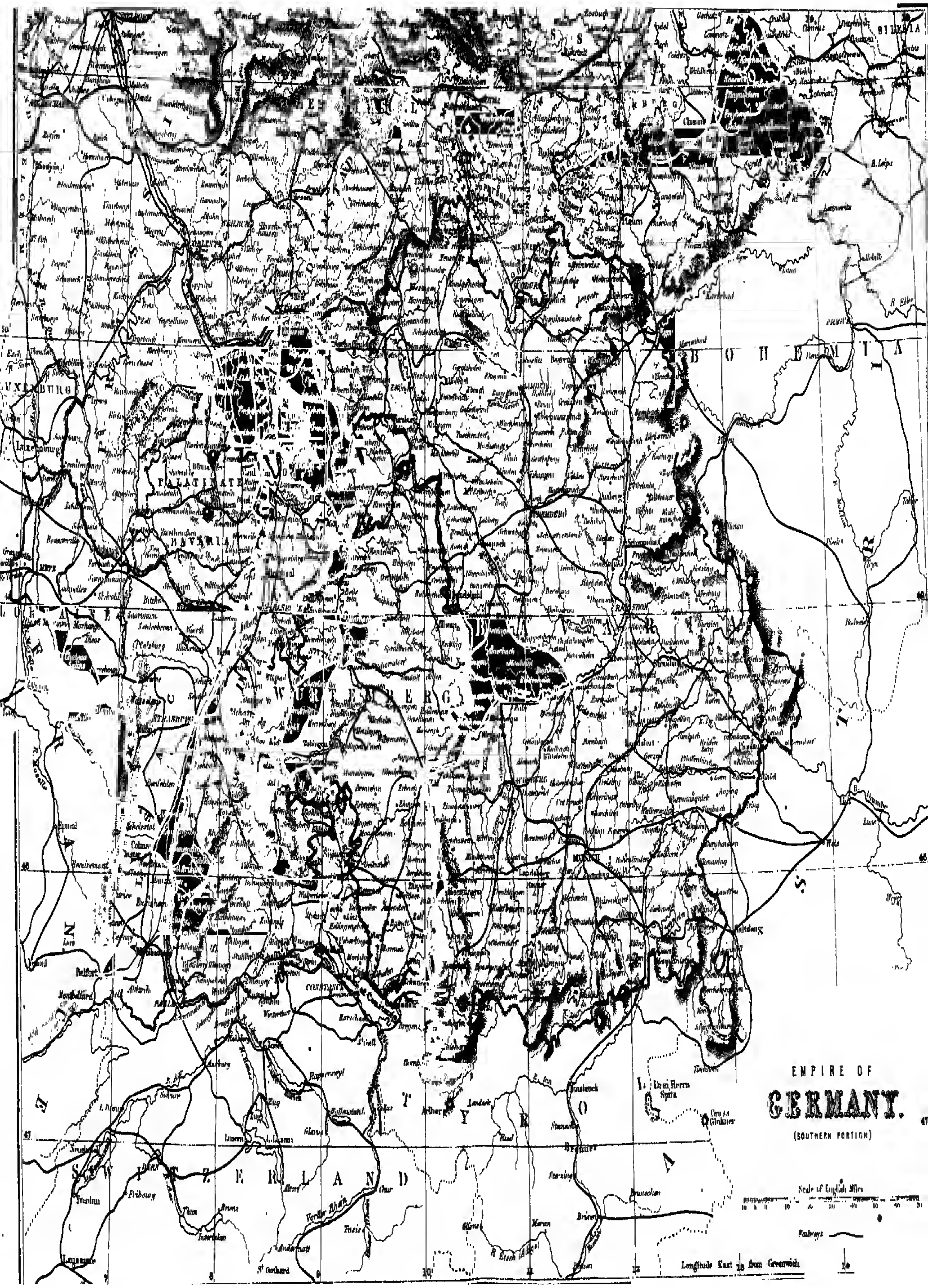
1 Boulder Clay. 2 Post glacial Gravel



WILLIAM MACKENZIE, LONDON, EDINBURGH & GLASGOW.



WILLIAM MACKENZIE, ... EDINBURGH & GLASGOW



WILLIAM MACKENZIE, LONDON, EDINBURGH & GLASGOW

GRALLÆ

Ciconia alba *White Stork*

Ephippiorhyncus senegalensis *Senegal Jabiru*

Platalea ajaja *Roseate Spoonbill*

Scopus umbretta *Tufted Umbre*

Glareola torquata *Collared Pratincole*

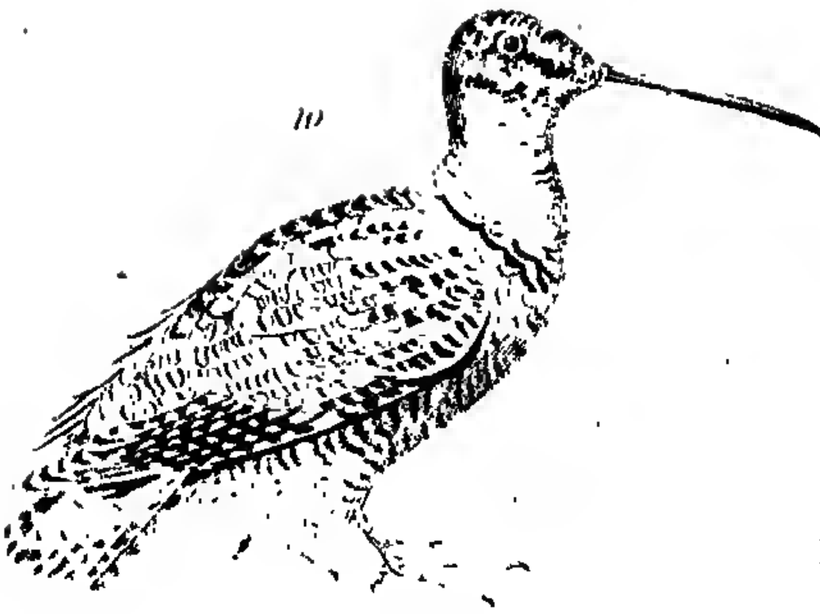
Charadrius pluvialis *Golden Plover*

Ardea cinerea Common Heron

Hæmatopus ostralegus *Pied Oyster catcher*

Botaurus stellaris Bittern.

10



Scolopax gallinago *Common Snipe.*

12

Parra sinensis *Chinese Jacana*

11

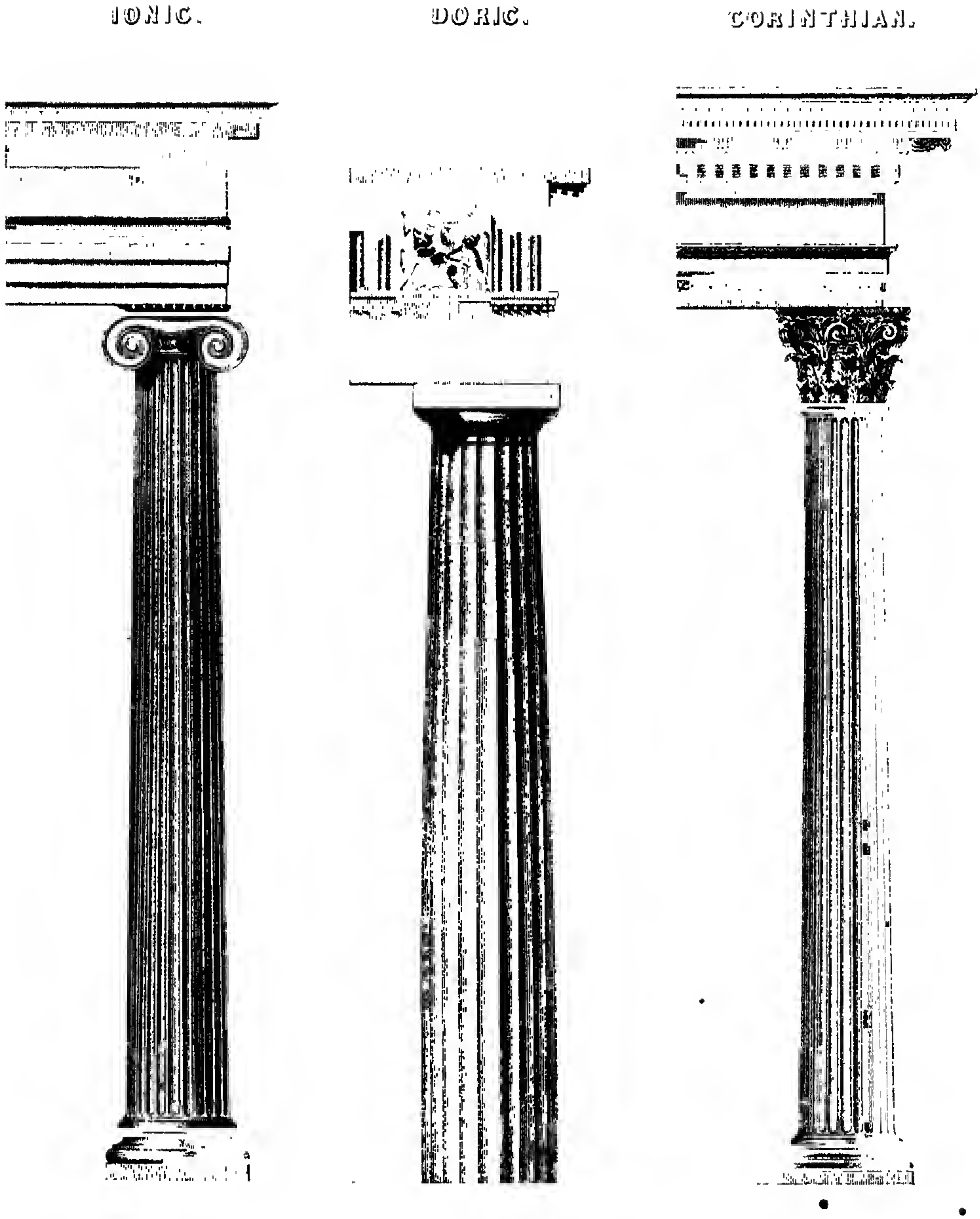
Rallus aquaticus *Water Rail.*

13

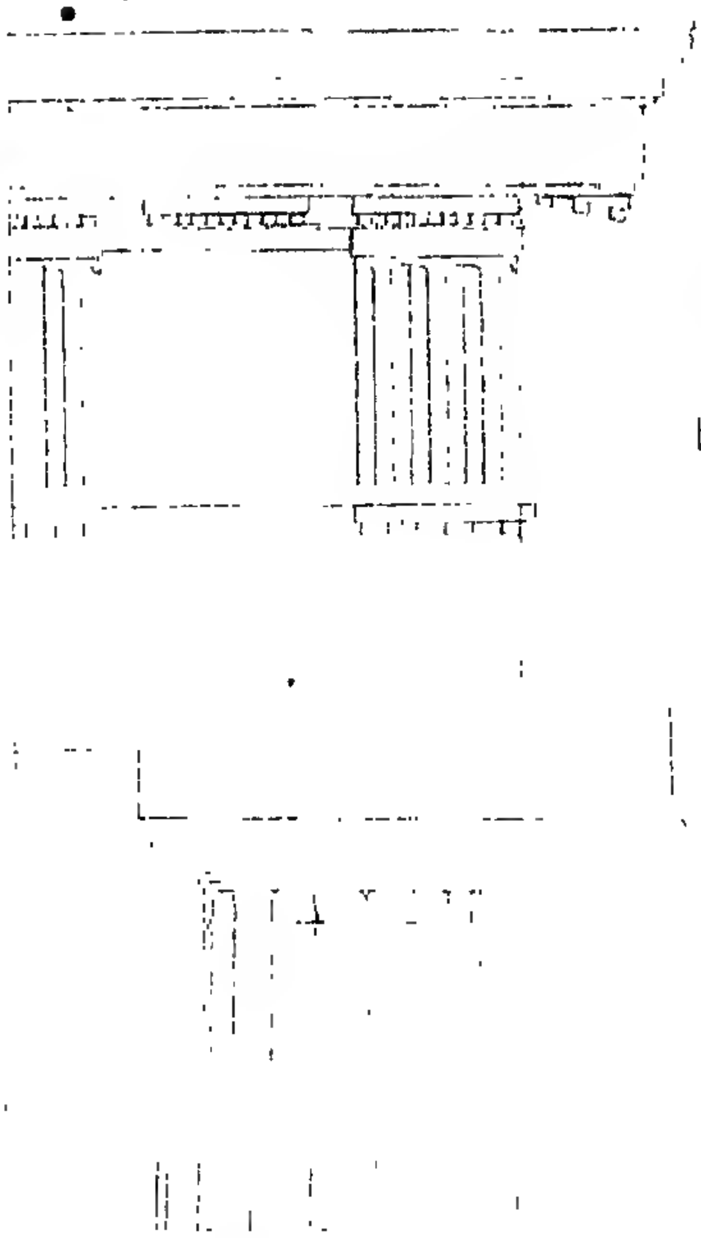
Palamedea cornuta *Horned Screamer*

GREEK ARCHITECTURE.

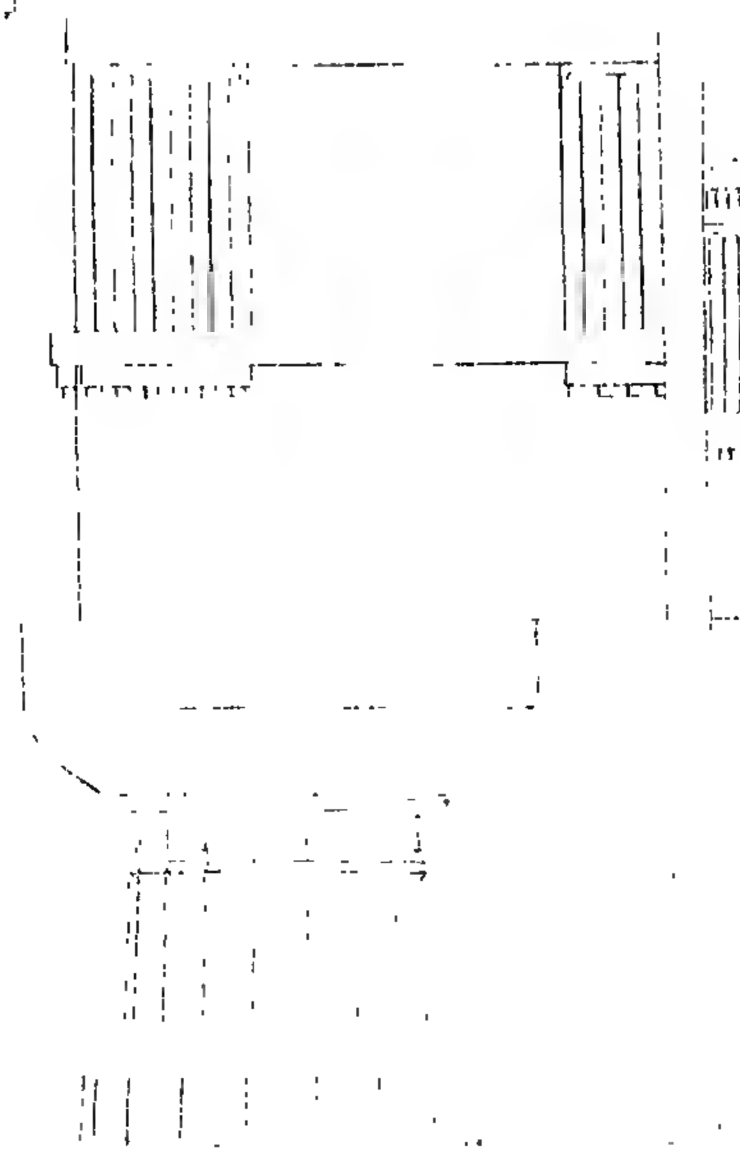
(THE THREE CLASSICAL ORDERS)



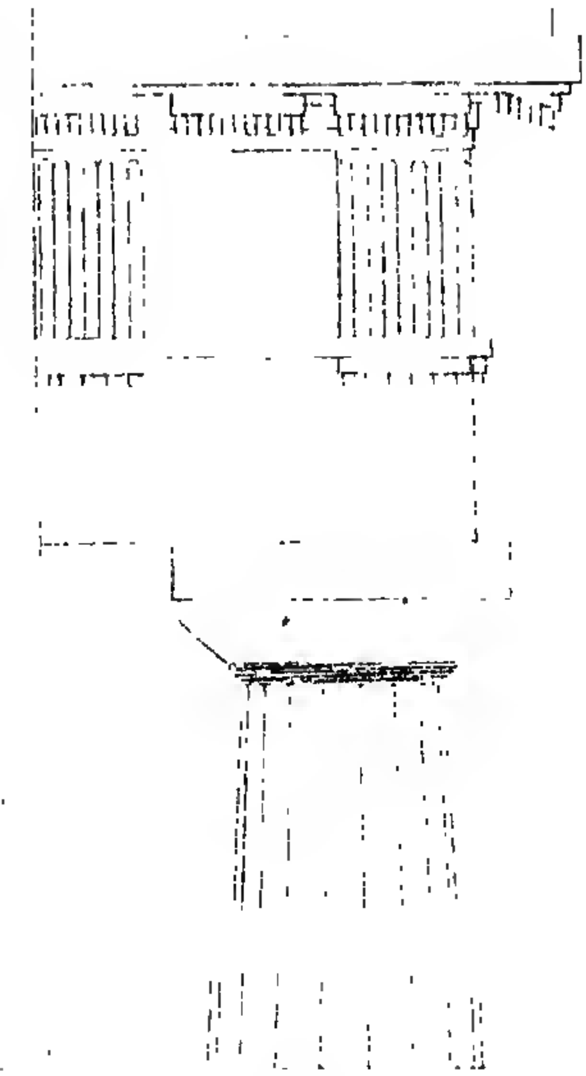
DORIC ORDER



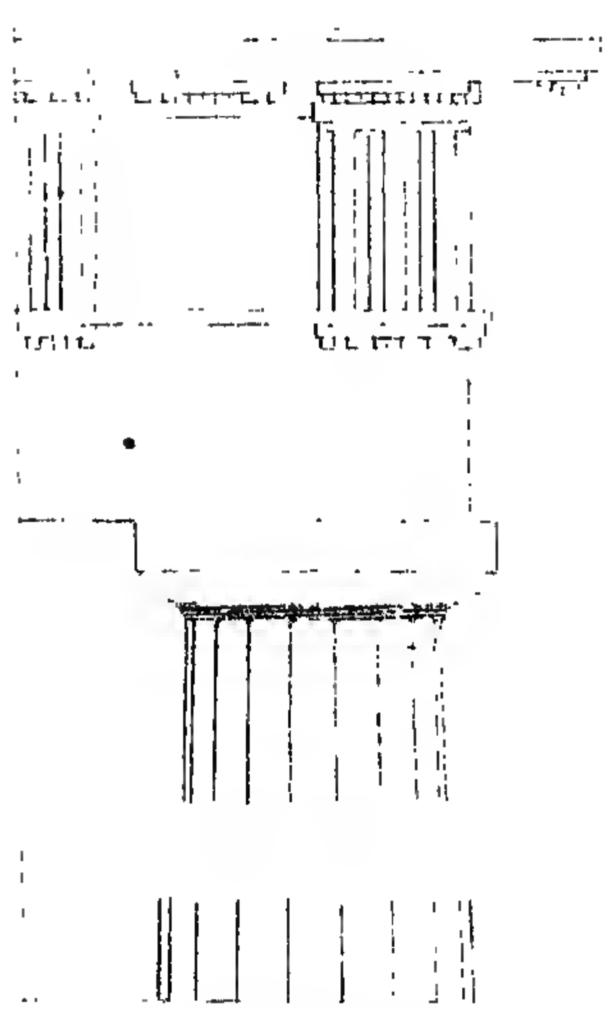
Temple of Athena at Athens



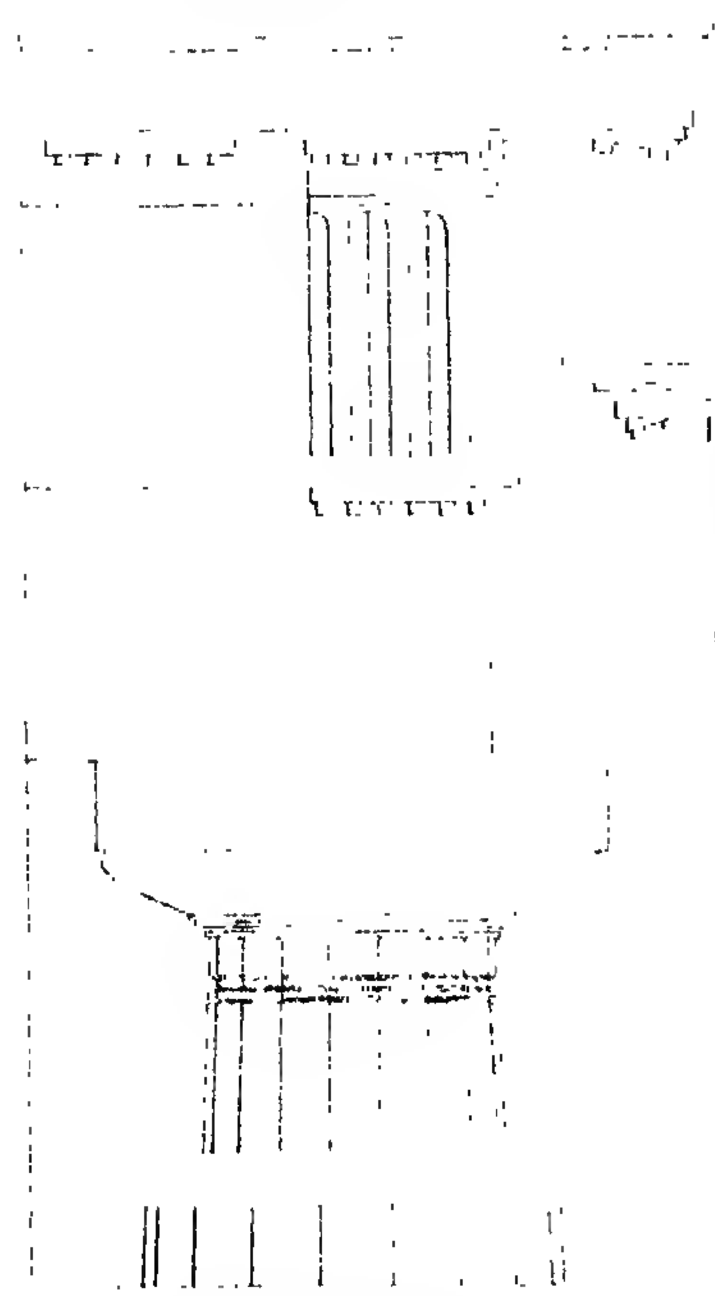
Temple of Here at Agrigentum



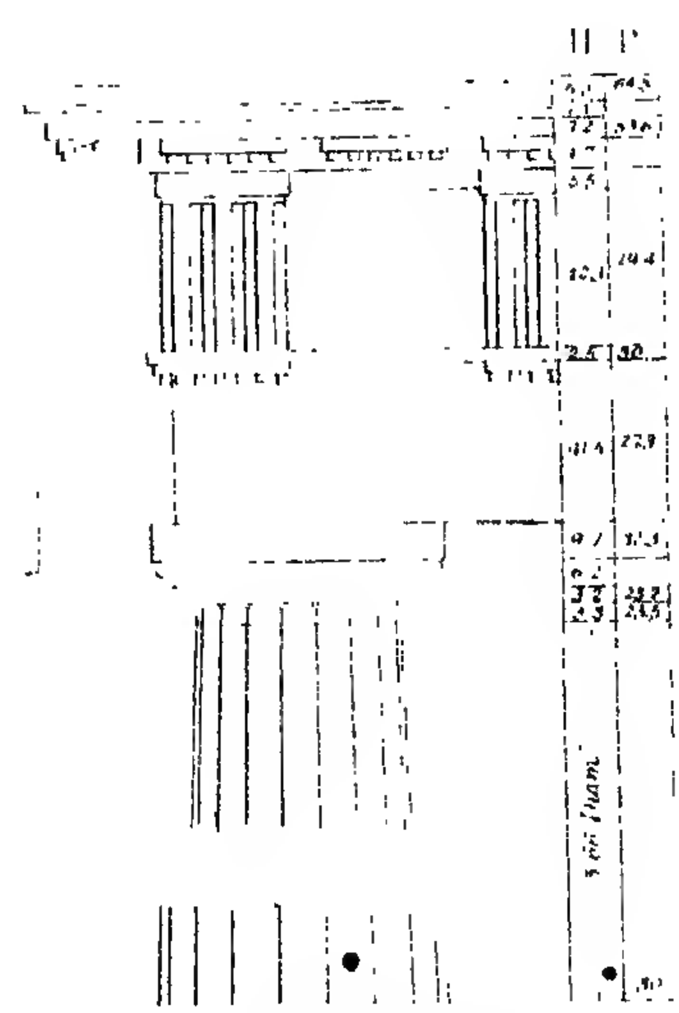
Temple of Concord at Agrigentum



Zeus Nemeus between Argos & Corinth.

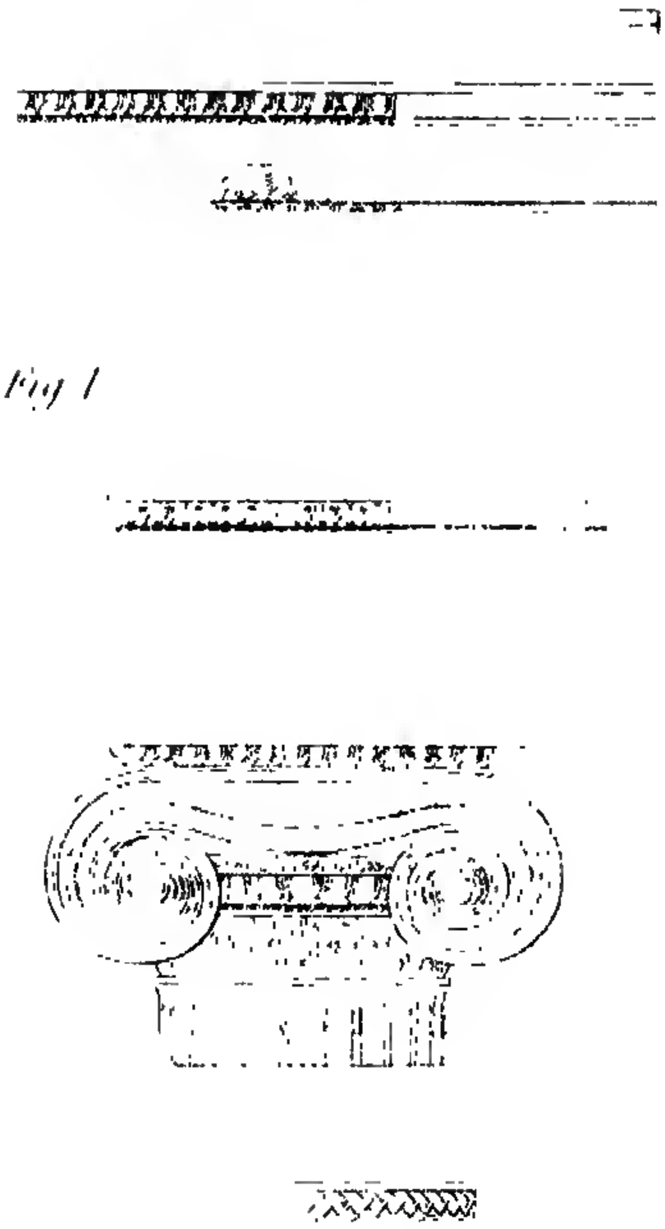


Hypæthral Temple at Pæstum



Portico of the Agora at Athens

Fig 1



Part of the Door way
Temple of Athenê Polias

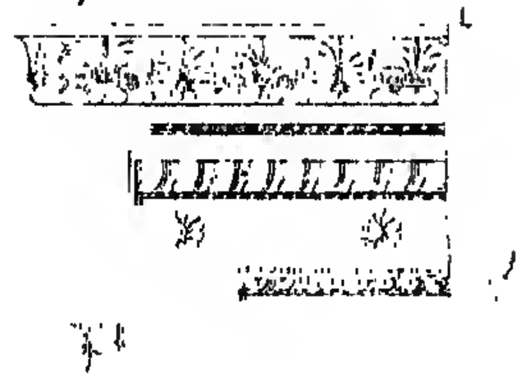


Fig 2

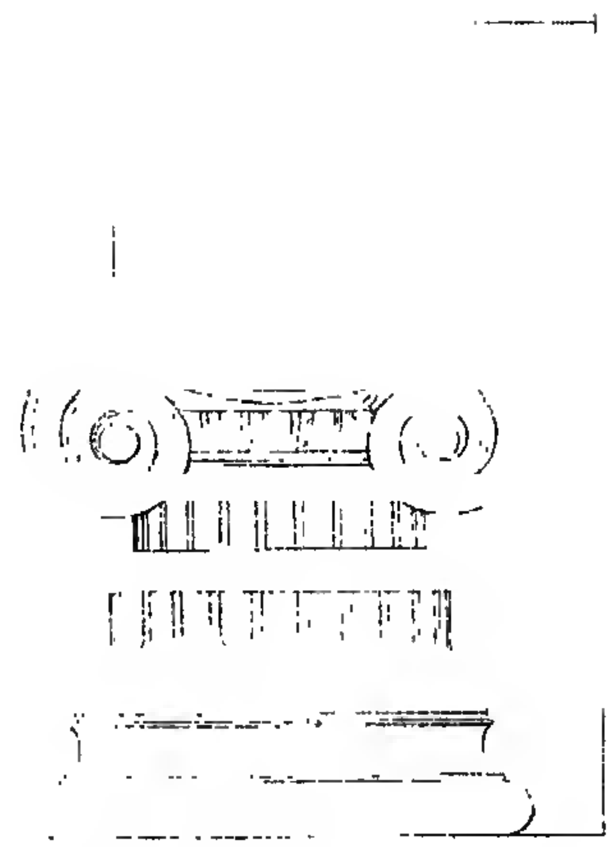
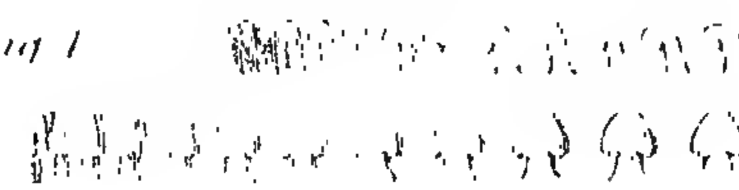


Fig 3

Temple of Athene Polias at Athens

From the Temple on the Ilissos

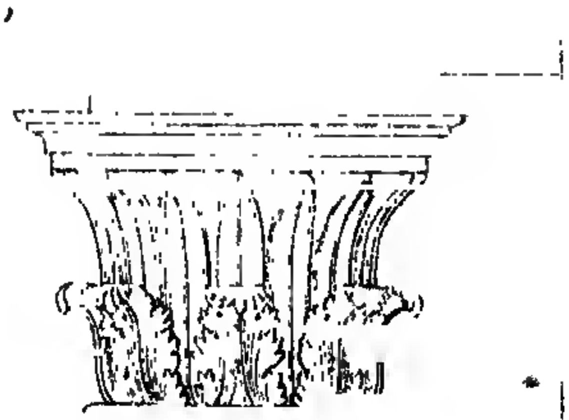
Fig 4



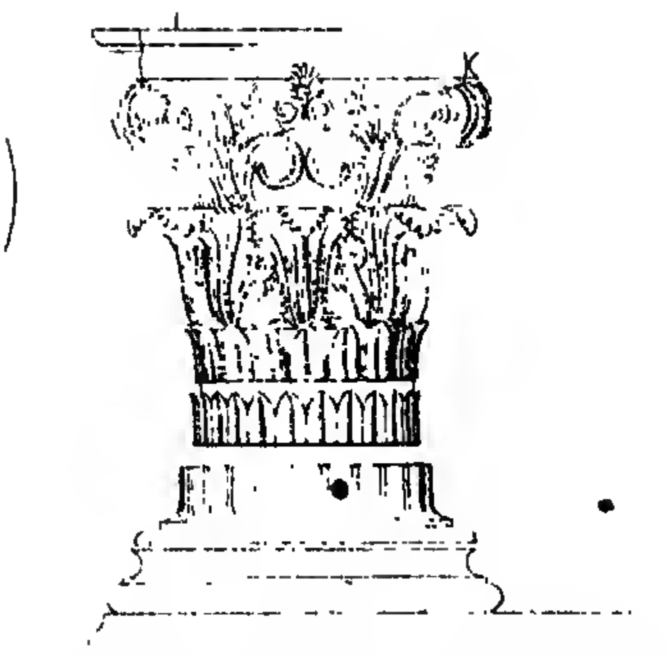
Window in the Temple of Athenê Polias

Fig 6

Fig 5



Fig

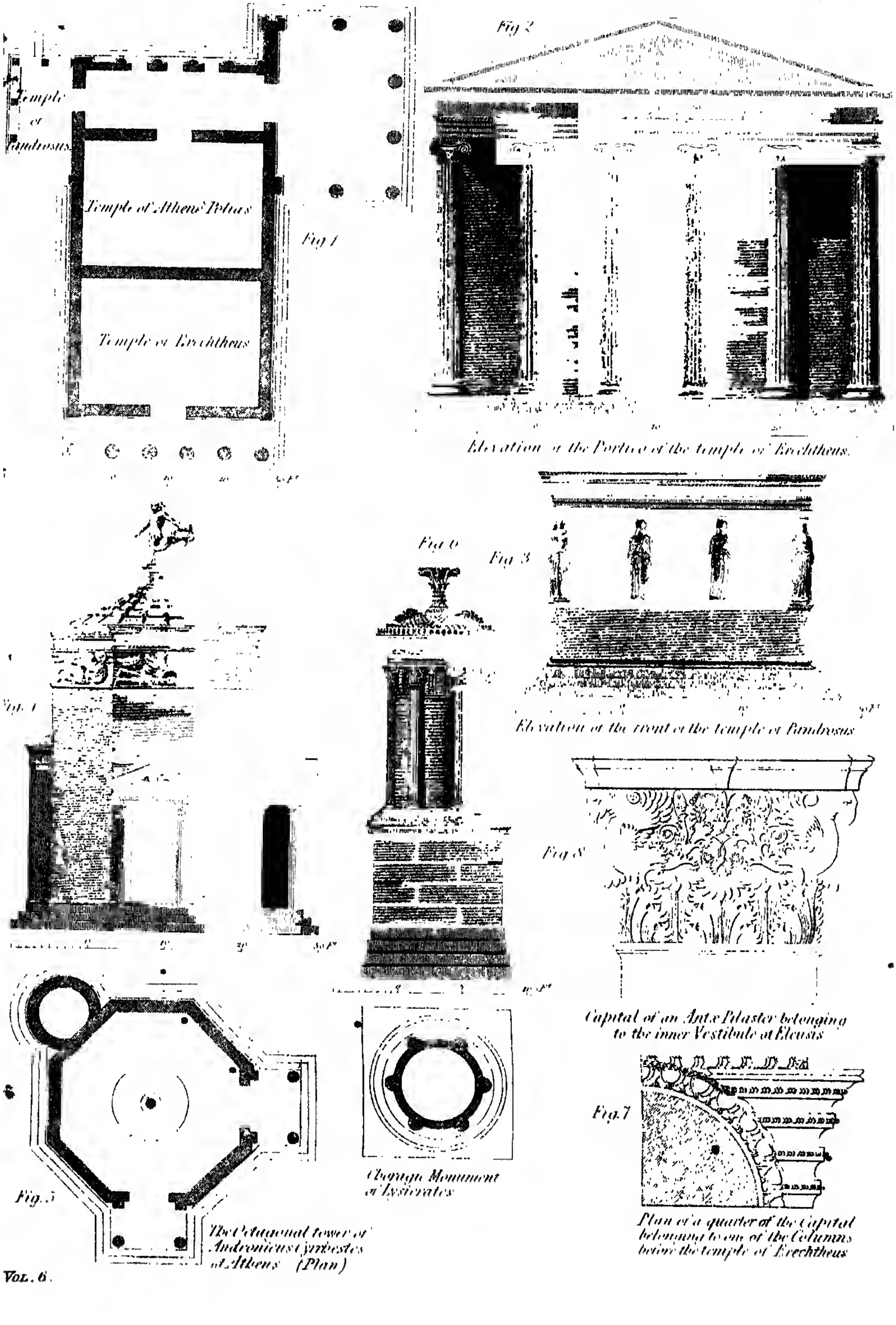


From the Octagonal Tower of Andronicus Cyrrhestes

From the Choragic Monument of Lysicrates

GREEK ARCHITECTURE.

PLATE 4.

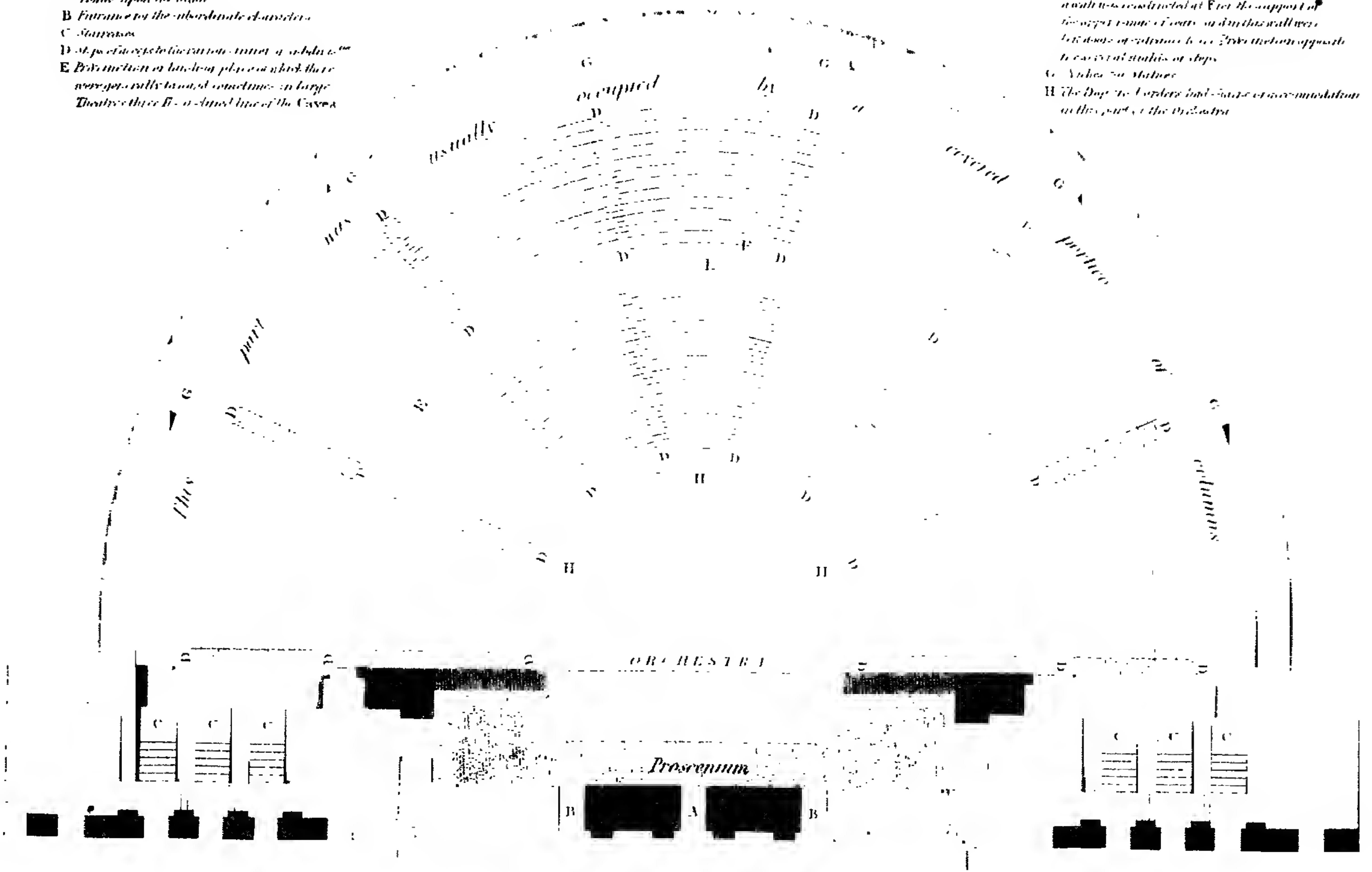


PLATE

(PLAN OF A GREEK THEATRE)

A Entrance by which the principal character comes upon the Stage
B Entrance for the subordinate characters
C Staircases
D [illegible]
E Præcinction or landing place on which there were generally formed, sometimes in large Theatres three E - a second line of the Cavea

[illegible] formed by the seats [illegible] a wall was constructed at F for the support of the upper range of seats, and in this wall were [illegible] doors of entrance to the Præcinction opposite to [illegible] stairs or steps
G Niches for Statues
H The Doors [illegible] accommodation in the [illegible] of the Orchestra



THE

NATIONAL ENCYCLOPÆDIA.

A DICTIONARY OF

UNIVERSAL KNOWLEDGE.

FLOWER-PECKER is the common name for the Dicæidæ, a small family of birds belonging to the order PASSERES and allied to the SUN-BIRDS (Nectarinia). This family is almost exclusively confined to India and Australia, only two species being found in Africa. As an example the beautiful little Swallow Flower-pecker or Swallow Dicæum (*Dicæum hirundinaceum*) may be taken. This bird is abundant in Australia, although from its minuteness it generally escapes the notice of the colonists. The male has the whole upper surface, including the wings and tail, black, glossed with steel blue; the throat and breast and the under tail-coverts are scarlet, and the abdomen is white, with a large black patch in the centre. The female is dull black above, with the throat and abdomen pale buff and the under tail-coverts pale scarlet. The length of the bird is about 4 inches. This bird is seldom if ever seen on the ground, being found principally upon the Casuarinæ, among the upper branches of which it plays about, uttering its pleasing song. It is especially partial to those trees which bear upon their branches a mistletoe-like parasite, of the genus Loranthus, upon the sweet and juicy berries of which it delights to feed, as was discovered by M. Verreaux. It also feeds upon insects, and according to Mr. Gould these constitute its principal nourishment. M. Verreaux indicates that it is by the agency of this bird that the parasite above referred to is transferred from one tree to another. The nest is a beautiful little purse-like structure, with an opening on one side; it is suspended from the twig of a tree, and composed of cotton-like fibres, obtained from the seed-vessels of plants. The eggs are three or four in number and dull white, with numerous brown spots scattered over their surface.

The flower-peckers are distinguished by having the edges of the mandibles very slightly denticulated, and by having small basal nostrils, and a short, square, or slightly-notched tail.

FLU'CERINE, a deutofluate of cerium, which occurs both massive and crystallized. The crystals are either six-sided plates or prisms; they have a yellow or reddish colour.

FLUE. See CHIMNEY.

FLU'ELLITE, a compound of fluoric acid and alumina, in colourless and transparent octahedral crystals.

FLU'ENTS. See FLUXIONS.

FLUE-WORK, in organs, a name given to the main stops of the organ—those constructed on the principle of the whistle, where the current of wind cuts against a sharp edge. Such are the diapason, the principal, the flute, &c. The other great division is the *reed-work*, where the current of wind is intercepted and made vibratory by a beating reed. In wind instruments the flute (or flageolet) and the clarionet are examples of the two different methods of producing musical tones from a current of air.

FLUID, FLUIDITY, are terms applied to substances of which the parts possess mobility among themselves. Fluids therefore include liquids and gases. Liquids have been generally treated as incompressible bodies, but this is not strictly correct. The particles of a liquid being surrounded by others which are subject to external forces, such as that of gravity, sustain pressure; and the particles can only be in repose when the pressures from all quarters are equal. When fluids are inelastic this pressure is entirely due to extraneous forces, such as the weight of the superincumbent mass.

The term fluid was formerly extended to the supposed media through which the forces of electricity, galvanism, and magnetism act; but as it is absolutely certain that these are not fluids the term, as leading to misconception, is now universally abandoned.

All ponderable matter exists either in the fluid or solid state; and most solids, when heat is applied to them, may be rendered fluid, under which circumstances mutual repulsion of particles takes the place of cohesion. As most solid bodies may be rendered fluid by heat, so many fluid bodies are converted into solids by diminishing their temperature. Solid bodies in becoming fluid render latent a large quantity of heat, and on the other hand fluid bodies in becoming solid evolve much sensible heat. Usually, but not invariably, solid bodies pass through the liquid state before becoming gaseous, and *vice versâ*. See HEAT.

FLUIDS, ELASTIC. This name may be applied to all the fluids in nature, since all are to a certain degree elastic; but it belongs particularly to such as are gaseous, liquid substances possessing little elasticity. Among the gaseous fluids, those which are usually considered as permanently elastic are called gases; and the term elastic fluid is frequently confined to atmospheric air and the vapours which are produced from solids or liquids by the action of heat. Many of the gases, on being combined with one another and with other substances, form solids or liquids; thus oxygen gas unites with metals and becomes solid, ammonia gas and chlorhydric acid gas unite and form the solid called ammonium chloride, while oxygen and hydrogen gas unite to form water. Almost all gases are invisible; but several which are so when they exist alone, become visible on being mixed with one another. Thus, binoxide of nitrogen when mixed with atmospheric air becomes visible and of a red colour. Most elastic fluids are transparent, but different quantities of light are absorbed in passing through these; and when the thickness of a stratum of fluid is considerable, the absorption is so great as to render an object beyond it invisible.

The elastic force of a dry gas at a given temperature is inversely proportional to the volume it occupies; and this law holds good both for mixtures of elastic vapours with each other, and of vapours with gases, provided no chemical action takes place between them. Thus different fluids of equal temperature and equal elastic force being introduced together in a close vessel whose capacity is equal to the sum of the volumes of the fluids separately, the fluids for a time remain separately in equilibrio; but experience shows that gradually the fluids intermingle with one another, producing a homogeneous fluid, preserving the same temperature and elastic force.

The temperatures at which liquids become elastic fluids by the action of heat are very various; chlorhydric and nitrous ethers boil, under the usual pressure of the atmosphere, at 55° and 62° Fahr. respectively; sulphuric ether boils at 96°, and acetic ether at 164°; water boils at 212°, while mercury can be made to boil only at a temperature of 744°. See GAS, VAPOUR.

FLUIDS, EXPANSION OF. The capacity of expansion of any fluid may be determined by filling a thermometer with it, in which the relation between the capacity of the ball and that of the stem is exactly known, and observing the height of the column at different temperatures. Care must, however, be taken to allow for the expansion of the glass itself, the observed result being the difference of the two. Most liquids are very irregular in their expansion. Even mercury, though regular up to 212° Fahr., shows above that point an unequal and increasing expansion when tried by the air thermometer. This expansion is compensated by the expansion of the glass for temperatures up to 204° C. (400° Fahr.) The following table from Peclet's "Élémens de Physique" shows the expansion of a number of liquids (between the freezing-point and boiling-point of water, 100° C. or 180° Fahr.):—

Water, ...	$\frac{1}{22}$
Hydrochloric acid, sp. gr. 1·137, . .	$\frac{1}{27}$
Nitric acid, sp. gr. 1·4, ...	$\frac{1}{9}$
Sulphuric acid, sp. gr. 1·85, . . .	$\frac{1}{17}$
Ether, ...	$\frac{1}{14}$
Olive-oil, ...	$\frac{1}{12}$
Alcohol, ...	$\frac{1}{9}$
Mercury, ...	$\frac{1}{54}$

A remarkable exception to the regularity of expansion in fluids exists in the case of water. Let a large thermometer tube be filled with this liquid at the common temperature of the air and then artificially cooled. The liquid will be observed to contract until the temperature falls to about 40° Fahr. (39·34° exactly), or 8° above the freezing-point. After this a further reduction of temperature causes expansion instead of contraction in the volume of water, and this expansion continues until the water reaches the point of congelation, when an enlargement so sudden and violent takes place as almost invariably to break the containing vessel. The force thus excited at the freezing-point is enormous. It has been known to split thick iron shells that had been filled with water, securely plugged, and exposed to a night's severe frost. It is a powerful agent in splintering and disintegrating rocks into the crevices of which it has found its way. This anomalous expansion of water has a very important application, and is a wise provision of nature, preventing as it does the freezing up of our lakes and the destruction of their fish during the winter. As the water on the surface cools down, it sinks to the bottom until the maximum density is reached; when the surface water freezes the coating of ice forms a protection to the water below, and the fish can still enjoy their native element. It is obvious that if cooling regularly increased the density the ice would sink to the bottom, the lakes would be rapidly frozen and thawed with great difficulty. The expansion of gaseous fluids is uniform. See GASES.

FLUKE is the old English name for the FLOUNDER, one of the most common British species of the flat-fishes (Pleuronectidæ); it also occurs as part of the common name of some other fishes of the same family found on our coasts, as the Craig-fluke, the Sail-fluke or Whiff, and the Salt-water Fluke or Dab. From the resemblance in shape to these fishes the name has been applied to certain Trematode worms, the liver-flukes, which, infesting the livers of sheep in great numbers, cause the disease known as the "rot" in those animals. See TREMATODA, LIVER-FLUKE.

FLUOBOR'IC ACID. See FLUORINE.

FLU'OR SPAR is a mineral crystallizing in the cubic system (the cube being the predominant form), having a hardness of 4, a specific gravity of from 3 to 3·25, and a very perfect octahedral cleavage. In composition it is pure calcium fluoride (CaF_2); the colours (in those varieties which are coloured) are due to organic matter. The mineral occurs massive as *chlorophane;* this variety is remarkable for showing a strong phosphorescent green light after being heated, the phosphorescence lasting several seconds. The crystallized mineral is generally transparent, sometimes colourless, but as a rule coloured, the colours being extremely various and often very beautiful. Pretty blue and green specimens are met with, notably in the Weardale (Durham) and at Alston Moor (Cumberland); pink crystals are found at Galenstock in Switzerland, red and yellow ones in Baden. A blue crystalline variety, known as "Blue John," is found in Derbyshire, and is highly prized for ornamental purposes, but is difficult to work on account of the readiness with which the mineral cleaves. A magnificent vase of this material is to be seen in the Museum of Practical Geology in Jermyn Street, London. The mineral is found in many parts of the world; the best localities (besides those before mentioned) are Cornwall (notably at Menheniot), the Saxon mining districts, Kongsberg in Norway, and Thunder Bay, Lake Superior.

FLUORES'CENCE. Solutions of certain substances, though perfectly bright by transmitted light, exhibit a sort of opalescent colour by reflected light quite different from the transmitted colour. A green variety of fluor-spar becomes deep blue by reflected light—hence the name. Uranian glass is extremely fluorescent; many of the aniline colours show this property. Solutions of quinine, though quite colourless by transmitted light, exhibit a blue fluorescence by reflected light, which is very characteristic. One of the most fluorescent bodies known is esculin, obtained from horse-chestnut bark. See ESCULIN.

FLU'ORINE is an element not known in a free state. It is believed to be gaseous, but its properties have not been fully investigated. It somewhat resembles chlorine. Its most familiar compound is the fluoride of calcium [see FLUOR SPAR], which exists in many animal substances, such as bones. It is pretty widely distributed in nature as the fluoride of calcium, traces of it being found in different plants; and it appears generally to accompany phosphate of lime in the bones of animals and in shells and corals. In certain fossil bones it is particularly abundant. The difficulty in isolating it has arisen from its extraordinary affinity for the metals. It has also an equally strong affinity for silicon, an element of glass, so that no glass vessel can be used in making experiments upon it. Vessels of lead or platinum must be employed.

The symbol of fluorine is F; its atomic weight, 19. The salts, which are extremely stable, are called fluorides. The fluorides much resemble the chlorides; they are mostly fusible, and are easily decomposed by chlorine and by sulphuric acid. The fluorides of the alkalies are soluble; those of the metals, except cadmium, tin, and silver, are insoluble. There are a number of double fluorides. As far as is known fluorine does not combine with oxygen.

The most important compound is fluorhydric or hydrofluoric acid (HF). This remarkable acid is obtained by distilling fluor spar with sulphuric acid in a leaden or platinum retort, provided with a condenser of the same metal. It is a colourless gas, which is very soluble in water, and which condenses at $-20°$ C. into a mobile fuming liquid. The aqueous acid boils at 15° C. (59° Fahr.), and has a specific gravity of 1·06. It dissolves glass and other silicates readily. It is a dangerously powerful caustic, and requires most careful handling. A drop on the hand produces ulcers very difficult to heal. It is usually kept in bottles made of gutta-percha, and is a good deal used in the etching of glass. The design is traced on the glass, previously coated with wax, and is then bitten out by the acid, applied either in the form of liquid or gas. If the former be employed the lines are transparent, it the latter the lines are opaque. Very light glasses which could not be cut can be thus engraved. This property forms an excellent test for the presence of fluorine or a fluoride.

When hydrofluoric acid acts on silica, or a substance containing it, a colourless gas of suffocating odour is formed, known as fluoride of silicon (SiF_4). It has a specific gravity of 3·6, and liquefies at $-140°$ C. under great pressure. It fumes strongly in the air, and when passed into water is absorbed; a portion of the silica is precipitated in a gelatinous state, and the solution contains silicofluoric acid or hydrofluosilicic acid ($2HF,SiF_4$), which with bases forms a number of salts called silico-fluorides. It is sometimes used as a test for potassium, the silicofluoride being one of the most insoluble salts of that metal. A somewhat similar compound is formed with boron, known as boron fluoride (BF_3), also a very heavy suffocating gas soluble in water. Its specific gravity is 2·31. Water absorbs 700 times its volume; the solution forms an oily liquid, of specific gravity 1·77, and is fluoboric acid ($B_2O_3 6HF$). It forms with bases a number of salts, mostly soluble in water, and called borofluorides.

FLUOSILIC'IC ACID. See FLUORINE.

FLUSH'ING (*Vlissingen*), a town and fortified port on the south coast of the island of Walcheren, in the Dutch province of Zealand. The port is formed by two moles, and beyond these are two canals which enter the town, in the interior of which they form two secure basins fit to receive the largest ships of war. The batteries by which the port is defended command the south entrance to the Scheldt. A capacious new harbour was completed in 1873. Near the exchange there is a statue of Admiral De Ruyter, who was born here in 1607. Few towns have suffered so severely from war and inundations. It hoisted the standard of revolt against the Spaniards immediately after the capture of the Briel in 1572. Together with some other towns it was given to England by the Prince of Orange in 1585, and remained in British possession till 1616. From 1809 to 1814 it belonged to the French. The population is 11,000.

FLUS'TRA. See SEA-MAT.

FLUTE, a well-known musical instrument, the use of which, under different forms and names, may be traced to the remotest periods of antiquity. The ancient flute had some sort of mouthpiece; it was double as well as single, that is, was often composed of two tubes, both played together. The old English flute was not unfrequently called the *flute à bec;* it had a mouthpiece, and was held in the manner of the clarionet. [See FLAGEOLET.] It had seven finger-holes and no keys. The flute à bec was gradually superseded about 1720 by that now in use, at first called *flauto traverso*, the German flute. The flute (by which is now always meant the *flauto traverso*) is now a cylindrical tube (formerly a conical one) open at the lower end and closed with a cork at the upper. About an inch from the cork is an orifice with sharp edges in the side of the flute, so that when held transversely and sloping downwards against the lip, with this orifice turned somewhat outwards, the current of wind from the mouth impinges upon the wedge-like margin of the orifice and becomes an "atmospheric reed," the vibrations of which quickly fall into harmony with the fundamental tone of the tube. In the ancient Egyptian flute the whole of the tube was brought to a feather edge and the wind blown against it; but that would be not so easy a method as our own, the latter indeed being found by beginners sufficiently difficult. Modern flutes have a large number of keys for the convenience of fingering, and give a compass from middle C (c') to three octaves upwards (c''''). They are made in boxwood, cocoawood, or ebony, and also in silver. The natural key of the flute is D.

The *octave flute* is a small instrument an octave higher than the common flute. The best of these are provided with four keys.

FLUTE-MOUTH is a name given to the Fistulariidæ, a family of fishes of the order ACANTHOPTERYGII, remarkable for the extreme elongation of the anterior part of the head, forming a tube, at the extremity of which is the mouth. The flute-mouths are gigantic marine sticklebacks. They are distributed over the tropical and subtropical parts of the Atlantic and Indo-Pacific. They are generally met with in shallow water near the shore. In the family Fistulariidæ the spinous dorsal fin is either formed of a series of feeble isolated spines, as in the genus Aulostoma, or is altogether absent, as in Fistularia. The branchiostegals are five in number. The species are few in number. In the genus Fistularia the body is without scales. This genus is remarkable for the condition of the anterior portion of the vertebral column, which forms a long compressed tube composed of four ankylosed vertebræ. This peculiarity is also found in the flying gurnard (Dactylopterus). The *Fistularia tabaccaria* of the Antilles is the type. It lives on little fishes and crustacea, which it draws out from the interstices of stones and holes in rocks by means of its long trunk or beak. Two other species are known, the *Fistularia serrata* and the *Fistularia depressa*, from the Indian Ocean. They are all slender and eel-shaped fishes, reaching a length of from 4 to 6 feet. In the genus Aulostoma the body is covered with small scales. Three other genera have been established.

FLUTE-STOP (*flauto traverso*, 8 feet), on the organ, is a range of wooden pipes tuned in unison with the diapason. It generally produces a very successful imitation of the instrument whence its name is derived. Other organ flute-stops are—the *flûte harmonique*, 16 feet long (sounding 8 feet pitch), an overblown stop, so voiced as to speak at the first harmonic, that is, at an octave above its prime tone, instead of at the prime tone itself; the *bass flute*, 16 feet, an octave below the diapason; the *wald flute*, or forest flute, of 4 feet pitch; the *hohl flöte*, or hollow sounding flute, usually 8 feet; the *octave flute*, the *stopped flute* (Gedackt flöte), &c. In fact, since all the flue-work of an organ is on the principle of a flute—that is, of the old English flute à bec—it would not be difficult to reckon up several score of "flute" titles adopted by organ builders. The above are, however, by far the most usual.

FLUX, in chemistry and metallurgy, is any substance employed to assist the melting and reduction of ores. Limestone is employed as a flux for clay-iron ore, and fluor spar for copper ore. The alkaline substance called black flux, which is carbonate of potash and carbon, is doubly useful in smelting ores; the carbonate of potash combines with the earthy parts of the ore, while the carbon unites with the oxygen of the metallic oxides, and carbonic acid being formed and expelled the metal is reduced and melts. White flux, or carbonate of potash, disintegrates stony matter, as alumina and silica, separates acids and sulphur from metals, and dissolves many metallic oxides. Argol, or bitartrate of potash, is much used as a

flux. Charcoal, glass, wax, tar, resin, pitch, fat, oil, gum, sugar, and starch are all occasionally employed for this purpose. Cyanide of potassium is much used as a flux; it acts also as a reducing agent.

FLUXIONS, FLUENTS. *Method, Notation, and Early History.*—The method of fluxions assumes a distinct conception of velocity both in the case of a uniform and a variable motion. It further extends this notion of velocity or rate of increase, derived from the consideration of a moving point, to all species of magnitudes, and even to expressions which are purely numerical, as the formulas of algebra. If one magnitude depend on another for its value, so that a change in the first produces a change in the second, and if the first be imagined to increase at a uniform and given rate, then the second will also increase or decrease, but not always at a uniform rate. But the rate at which y increases, though varying with the values of x, can in all cases be determined; and supposing $\dot{x}$ to be the velocity with which x increases, and $\dot{y}$ that of y, an equation can always be produced of the form—

$$\dot{y} = \left\{\begin{matrix}\text{a function of } x \text{ and } y\text{, depending on}\\ \text{the equation which connects them}\end{matrix}\right\} \times \dot{x}.$$

In this case x and y were called by Newton *flowing* quantities, and $\dot{x}$ and $\dot{y}$ were called their *fluxions:* conversely y and x were called the *fluents* of $\dot{y}$ and $\dot{x}$. The velocity of y, being variable, may itself be considered as having a rate of change. Thus, if the velocity of a body increase uniformly, the whole velocity gained in a second may be called the velocity of the velocity, or the fluxion of the fluxion. Newton denoted these second fluxions by $\ddot{y}$ and $\ddot{x}$. In a similar way might be determined the velocity of $\ddot{y}$, denoted by $\dddot{y}$, and so on. We cannot find that Newton proposed any symbol for the fluent of a fluxion except the inclosure of its expression, and that only casually; thus—

$$\boxed{3x^2\dot{x}} \text{ is the fluent of } 3x^2\dot{x}, \text{ or } x^3.$$

He also, in his treatise "De Quadratura Curvarum," used z' to stand for the fluent of z.

We now come to the history of this discovery, and of the dispute relative to the right of invention.

The biographers of Newton state that about the year 1668 he began to turn his attention to the writings of Descartes and Wallis, and Newton himself testifies that he invented the method of series and fluxions in the year 1665, and that in a tract written in 1666 he had begun to use the notation of fluxions. Various letters of Newton, Collins, and others, up to the beginning of 1676, state that Newton had invented a method by which tangents could be drawn, &c., without the necessity of freeing their equations from irrational terms. Among them is a letter of Newton to Collins, dated 10th December, 1672, in which he states the fact of his discovery, with one example. This letter the committee of the Royal Society assert, but without proof, was sent to Leibnitz. Their original report does not even give the date of transmission; but an asserted date is surreptitiously introduced into the second edition of it, after the death of Leibnitz. Leibnitz desired to have this method communicated to him; and Newton wrote to Oldenburg the celebrated letters of 13th June and 24th December, 1676. In the first he states the binomial theorem, and various consequences of it in combination with his method, but without giving any information as to that method. Newton in the second letter explained how he arrived at the binomial theorem, and gives various results of his method. He also communicated his method of fluxions and fluents ***in transposed letters*** (as was often practised at the time). Thus Newton gravely tells Oldenburg that his method of drawing tangents was—

$$6\,a\,c\,c\,d\,æ\,13\,e\,f\,f\,7\,i\,3\,l\,9\,n\,4\,o\,4\,q\,r\,r\\4\,s\,9\,t\,12\,v\,x;$$

or, that if anyone could arrange six a's, two c's, one d, &c., into a certain sentence he would see the method. That sentence was, "Data æquatione quotcunque fluentes quantitates involvente fluxiones invenire, et vice versâ." This letter of 24th October, 1676, had not been sent to Leibnitz by 5th March, 1677, as Collins informs Newton by letter of that date. As early as 21st June of the same year, however, Leibnitz had received that letter and written an answer to Collins, in which, without any desire of concealment, he explains the principle, notation, and use of his DIFFERENTIAL CALCULUS. Newton wrote the celebrated scholium, fully admitting the independent discovery of Leibnitz, of which he was afterwards weak enough, first, to deny the plain and obvious meaning, and secondly, to omit it entirely from the third edition of the "Principia."

Nothing material passed till 1684, in which year Leibnitz gave his first paper on the differential calculus in the *Leipzig Acts.* In 1687 the "Principia" was published by Newton, and Leibnitz continued to give papers on the subject of his new calculus. Dr. Wallis informed Newton, by letter of 10th April, 1695, that "he had heard that his notions of fluxions passed in Holland with great applause by the name of Leibnitz's Calculus Differentialis;" and Wallis mentioned this fact also in a preface to his works as a reason for not treating of that calculus.

In 1699 Fatio de Duillier, a Genevese settled in England, stated in a mathematical work his conviction that Newton was the first inventor, adding that he left to those who had seen the manuscripts and letters to say whether Leibnitz borrowed from Newton. This was the first distinctly expressed suspicion of plagiarism; and Leibnitz, who had never contested the priority of Newton's discovery, and who appeared to be quite satisfied by Newton's admission, now appears for the first time in the controversy. In a reply to Duillier (*Leipzig Acts*, 1700), after calling attention to Newton's scholium, he declares that when he published his method in 1684 he knew nothing more of any method of Newton, except that the latter had written to him that he could dispense with the removal of irrational terms; and that, though on the publication of the "Principia" he became aware how much further its author had pushed his discoveries, he did not know that Newton possessed a ***calculus*** (or organized method) like the differential till the publication of Wallis's preface.

The "Quadrature of Curves" was published by Newton in 1704 at the end of his "Optics." It contains a formal exposition (the first published) of the method and notation of fluxions. Since so great a stress was laid by the parties to the quarrel on the introduction of specific notation, we may remark that Newton himself did not very soon adopt such a course. He says that in 1666 he "sometimes used a letter with one prick for quantities involving first fluxions, and the same quantity with two pricks for quantities involving second fluxions." Even so late as 1687 he does not (in the "Principia") give any notation for the ***momenta*** to which he had given a name, and we doubt whether Newton would ever have systematized his notation if he had not seen the letter of Leibnitz referred to in the scholium.

A review of the above work appeared in the *Leipzig Acts*, January, 1705, in which, after stating that the differential calculus had been explained in that work by Leibnitz, its inventor, and further by the Bernoullis and De L'Hôpital, the author proceeds to imply, to all appearance, that Newton had used the method of Leibnitz. This called forth the assertion of Keill (*Phil. Trans.* 1708), that Leibnitz had inserted Newton's method, changing its name and notation, in the *Leipzig Acts.*

Leibnitz, on the receipt of this volume (March, 1711), complained of the accusation in a letter to Dr. Sloane (then secretary of the Royal Society). After some correspondence the Royal Society appointed a committee, which collected and reported upon a large mass of documents, consisting mostly of letters from and to Newton, Leibnitz, Oldenburg, Wallis, Collins, &c., and judged that Leibnitz's method is in fact the same as that of Newton, with a difference of name and notation; finally, that Newton being the first inventor, Keill, in asserting the same, had been no ways injurious to Leibnitz. This report, preceded by a large mass of letters or extracts, appeared in the year 1712, under the name of "Commercium Epistolicum," and again with a Recensio, &c., prefixed in 1722.

Leibnitz only protested in private letters against the injustice of the proceeding. He declared that he would not answer a reasoning so weak; and it appears, moreover, that he had on his mind an impression that the acrimony excited against him in England was political. He was in the service of the Elector of Hanover, the health of the queen was declining, and many of the men of science were Jacobites.

With regard to the "Commercium Epistolicum," and the Report attached, it was obvious that the final conclusion was not to the point. The question was not whether Newton was the first inventor, but whether Leibnitz had stolen the method, as he had been accused of doing.

FLY, in its widest significance, means any winged insect. The large majority, however, of those insects popularly known as flies fall under the zoological order DIPTERA, or two-winged insects, an order which is co-extensive with the old Linnean genus Musca. This genus, now greatly restricted, forms the type of a family Muscidæ, and to this family it is convenient to restrict the name fly.

In the family Muscidæ the proboscis is terminated by a sucker composed of two large fleshy lobes; it is completely retractile within the mouth. The antennæ have three joints, and are usually short, the last joint being the largest; the wings are sparsely veined; the alulets are frequently altogether absent or very minute; the body is short and tolerably broad; the abdomen consists of five segments.

Great as is the diversity of form in this family the variety in habits is still more striking. Among the perfect insects are found "flower-lovers feeding on honey, bloodsuckers, flies preying on others, flies oviparous and ovoviviparous; among the larvæ are found some terrestrial and some aquatic, carrion feeders, vegetarians, and wine-bibbers; parasites in the nests and parasites in the bodies of other insects (and even in the bodies of vertebrate animals); gall-makers and leaf-miners." (Staveley. "British Insects.") The larvæ of flies are generally known as maggots.

Some flies are exceedingly common and well-known to all, such as the house-fly, the bluebottles and greenbottles, the flesh-flies and the flower-flies.

The House-fly (*Musca domestica*) is too well known to need description. It may be, however, noticed that its proboscis is adapted for sucking up fluid substances, and is incapable of piercing the skin and inflicting a bite. It is enabled to feed on soluble dry substances by moistening them with a clear liquid emitted from its mouth. A fly closely resembling the common house-fly, and like it frequently found in our houses, can pierce the skin and suck the blood. This fly is named *Stomoxys calcitrans*, and may be distinguished from the harmless inhabitant of our houses by its long slender proboscis, which projects in front of the head. The Bluebottle-flies (*Musca vomitoria* and *Musca erythrocephala*) and the Greenbottle-flies (*Musca cæsar* and *Musca cornicina*) lay their eggs in meat. In the Blow-fly or Flesh-fly (*Sarcophaga carnaria*) the eggs are hatched in the oviducts, and the larvæ are born alive, as many as 20,000 being produced. They feed on dead animal substances of all kinds, proving very useful scavengers. The Flower-flies (Anthomyia) deposit their eggs in manure or in the roots of vegetables. The perfect insect frequents flowers. The species of the genus Tephritis deposit their eggs upon living plants, often producing gall-like excrescences. The larvæ of the genus Chlorops inflict great injury on corn crops. *Drosophila cellaris* deposits its eggs in fermented liquors. The cheese-maggot or cheese-hopper is the larva of *Piophila casei*.

FLY-CATCHER is the common English name for the Muscicapidæ, a family of Passerine birds belonging to the section DENTIROSTRES. The birds of this family are characterized by having a rather short but broad and depressed bill, with the gape very wide, running back nearly as far as the eyes, and fringed on each side at the base with long and strong bristles springing from the upper mandible. The legs are generally short and slender. The exact limits of the Muscicapidæ are uncertain. Many of the birds formerly associated with the true fly-catchers have been recently removed from this family, such as the greenlets (Vireonidæ), tyrant birds (Tyrannidæ), the wood-warblers (Mniotiltidæ). The Muscicapidæ, as restricted by modern ornithologists, form still a very numerous family, comprising nearly 300 species. The fly-catchers, as their name denotes, are strictly insectivorous in their habits, living upon flies, which they capture on the wing. They are in the habit of perching upon some post or rail, or on the branch of a tree, watching for the passage of insects, in pursuit of which they immediately dash off, returning again to their original position when the capture is effected, there to look out for more.

The best known bird of this family is the Common or Spotted Fly-catcher (*Muscicapa grisola*). It is a summer

Fly-catcher (*Muscicapa grisola.*)

visitor to Great Britain as well as to the rest of Europe, but is found in less abundance in Scotland and Ireland. It is one of the last birds to arrive in this country, usually making its appearance in the south about the 20th of May; but in the course of the summer it diffuses itself very generally over the whole island, and may be seen almost everywhere taking up its position of observation upon a post or paling, and performing its short irregular flights in pursuit of passing insects. This bird is sometimes accused of devouring cherries and raspberries, but probably without cause; its object in visiting these fruits when ripe being no doubt to feed upon the flies which are attracted by them, as no remains of fruit have ever been found in its stomach.

The nest of this bird is usually placed in the side of a faggot stack, a hole in a wall, or upon a beam in some outhouse, but sometimes in trees, especially when trained against a wall. The nest is cup-shaped and neatly constructed of moss, roots, and grass, usually lined with hair, wool, and feathers. The eggs are four or five in number, bluish-white, with pale red spots. The common fly-catcher is between 5 and 6 inches in length; it is of a brown colour, white with streaks of brown beneath.

Another British species is the Pied Fly-catcher (*Muscicapa atricapilla*). It is comparatively rare in England, being most abundant in the lake district of Cumberland and Westmorland. It is smaller than the common fly-catcher. The male is black above and white beneath, with a spot above the base of the bill; the female is brown above and dull white beneath, and is destitute of the white spot on the forehead. In its general habits this bird resembles the spotted fly-catcher; but its nest, which is loosely made of grass and roots, is placed in the hole of a decayed oak or other pollard tree. The eggs, of which there are sometimes as many as eight in one nest, are of a uniform pale blue colour. Other species of the genus Muscicapa are found in Europe, as well as in Africa and Eastern Asia.

The Paradise Fly-catchers (Tchitrea) are remarkable for the difference in the plumage in the sexes. The male usually puts on a pure white plumage, while the female is usually of a chestnut colour. The male is further distinguished by the great elongation of the middle feathers of the tail, which are about 15 inches long. In both sexes the head is adorned with a small pointed crest of a glossy steel-blue colour. The common paradise fly-catcher is found in all parts of India and in Ceylon. It is abundant in the woods and dense jungle, and is restless in its habits, feeding upon insects, which it captures in the air as it flits about, making a loud snap with its bill as it seizes its prey.

A remarkable fly-catcher is the Restless Fly-catcher (*Sisura volitans*), an abundant species in all the southern parts of Australia, where it is known to the colonists as the Grinder or the Razor-grinder, from a remarkable noise which it emits while engaged in the pursuit of its prey. It feeds on insects, which it not only captures in the air in the ordinary manner of the fly-catchers, but also by flying over the fields, with regular beats of the wings, like the kestrel, and dropping perpendicularly upon any insect which it perceives beneath it. The flight of the bird is described as peculiarly graceful, and forms a striking contrast to the harsh grinding note uttered by it. Mr. Gilbert seems to think that this note is emitted for the purpose of attracting the notice of the insects below; for he observed that, after uttering the cry, the bird always descends to the ground, picks up something, and carries it off to the nearest tree. The restless fly-catcher is about 8 inches in length. The plumage is black above and white beneath, and the breast often exhibits a pink tint. The nest is cup-shaped, neatly made of fine grasses held together by cobwebs, and lined with fine roots, and sometimes a few feathers. Another genus of this family is Rhipidura, containing the FANTAILS.

FLYING BRIDGE. This consists usually of a boat or other vessel, which, being attached by a rope to a buoy moored in the middle of a river, is made by the action of the current to move across on an arc of a circle of which the buoy is the centre. On large rivers, at places where the communications across them are very frequent, such bridges are now very generally superseded by steam-vessels; but for temporary purposes, and particularly to facilitate military operations in countries where steam navigation is not in use, they are still of the highest importance.

The buoy being securely anchored in the middle of the river, a rope or chain leads from thence to the mast of the boat, which is at a distance from the head equal to one-third of the vessel's length; then, the keel of the boat being kept at a certain angle with the direction of the current, a resolved part of the pressure of the water against one side of the boat will cause the latter to describe an arc of a circle across the river. In theory, the angle which the keel should make with the direction of the current, in order that the force by which the boat is impelled across may be a maximum, is 54° 44′.

In a rapid current it may be impossible to make the boat move up the ascending arc of its path, in which case a boat near one bank may, by means of a cable made fast at a point directly opposite on the other bank, be allowed to describe a descending arc quite across the river. In order to return, the boat must first be drawn up along the bank at which it has arrived, as far as the spot at which the cable was made fast, and then be hauled directly across the river to the spot from whence it first set out.

When the river is too wide for a boat to swing over in a single arc, two buoys may be moored in a direction across the river, at equal distances from the banks and from each other, and two boats connected with them by ropes may be impelled in circular arcs, one extending over the first half of the breadth of the river, and the other over the second; a raft being moored in the middle facilitates the transference of the passengers, &c., from one boat to the other; or, without the raft, one boat, on arriving in the middle of the river, may transfer its passengers immediately to that which is to describe the other half of the breadth.

A triangular raft, having its front parallel to the direction of the current, and being connected by a ring with a rope stretched tightly across the river, may by a resolved force of the current be impelled directly to the opposite bank, and on reversing its position the raft may be impelled across in a contrary direction. A boat running by a ring at one end, on a rope, may, by being kept in an oblique position, in like manner be *sheered* across the river.

On broad rivers, and when objects of great bulk and weight, as horses, carriages, or artillery, are to be conveyed across, two boats or barges placed in parallel positions, and carrying a platform extending between their exterior gunwales, are employed. Each vessel is provided with a mast, which may be from 20 to 30 feet in height; these are connected together by two horizontal beams, one above the other, and between them is a block of wood which is capable of sliding from one mast to the other. The cable or chain is made to pass through a perforation in the sliding piece, and the latter is placed contiguously to either mast, according to the direction in which the vessels are to move.

FLYING BUTTRESS. See BUTTRESS.

FLYING DUTCHMAN, THE. A favourite theme in the legends of the middle ages was the futility on the part of man of a struggle with supernatural powers. Among such legends that of the *Flying Dutchman* must be numbered. Here Van der Decken, the master of a vessel named the *Flying Dutchman*, blasphemously swore one stormy night to make the Cape or be damned for ever. According to the legend he was taken at his word, and the ship is still to be seen, especially when the weather is at its worst, flying before the wind with every stitch of canvas spread. The subject has been finely treated by Heine, and in an operatic form by Wagner.

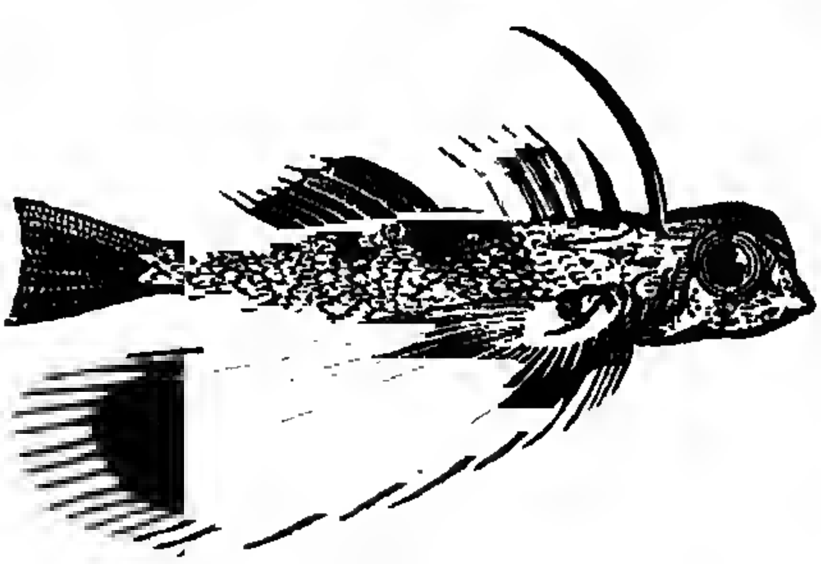
FLYING FISH is a name given to certain fishes that have the power of sustaining themselves for a short time in the air. This power, which is not one of true FLIGHT, these fishes are enabled to exercise by means of the great development of the pectoral fins, which act as parachutes. Flying fishes are of two very distinct kinds. The fishes to which the name is usually restricted are species of the genus Exocœtus, which belongs to the same family (Scombresocidæ) as the garfish, and to the order Physostomi, while the FLYING GURNARD (Dactylopterus) is nearly allied to the gurnard, one of the Acanthopterygii. The former genus will alone be considered in the present article. The distinguishing characters of the genus Exocœtus briefly are—pectoral fins nearly equal to the body in length; head flattened above and on the sides; the lower part of the body furnished with a longitudinal series of keeled scales on each side; dorsal fin placed above the anal; eyes large; jaws short, furnished with pointed teeth,

which are minute and sometimes absent. The pectorals vary in length in different species; in those in which the power of flight is best developed the pectorals extend to the caudal fin, in others they extend only to the anal. Much diversity of opinion exists as to the purpose and mode of the flight of the flying fish. The facts seem to be these: the original impetus is given by the tail while still in the water, the pectorals act simply as parachutes and cannot be moved like the wings of birds, and the fish has no power to change the direction of its flight or to sustain itself in the air beyond a very limited time. The flight is very rapid, and in some instances has extended as far as 200 yards. Any deviation from a straight course is caused by the currents of the air, to control which is utterly beyond the fish's power. Occasionally the fish alters the direction of its flight by dipping its tail into the sea and striking the water with it. Flying-fishes fly close to the surface of the water, in a calm never rising above a height of 2 or 3 feet; in a breeze they are often carried by the wind high enough to fall on board ships. They are most frequently seen in rough weather. Though their flight is often a means of escape from their many enemies, as bonitos, tunnies, and porpoises, they often leave the water without any apparent external cause. The species of the genus Exocœtus are very numerous and widely distributed.

The flying fishes visit our seas in comparatively small shoals; but in the warmer districts of the ocean they exist in extraordinary numbers, and are never-failing objects of contemplation and speculation to navigators crossing the tropics. Multitudes are taken in the West Indies, and in Barbadoes they constitute an important part of the negro diet. Two thousand people are estimated to live by the fishing, which is carried on at some distance from the shore during the night, with hoop nets baited with pounded fish. The usual length of the flying fish is about 10 or 12 inches, but it sometimes considerably exceeds that length.

FLYING FOX. See FRUIT BAT.

FLYING GUR'NARD (Dactylopterus), a genus of fishes remarkable for the immense fan-like extent of their pectoral fins, which, acting as parachutes, enable them to sustain themselves in the air for a short period of time. Hence they are called flying fishes or flying gurnards; but they must not be confounded with other flying fishes of the genus Exocœtus which possess the same powers.



Flying Gurnard (*Dactylopterus orientalis*).

The flying gurnards are distinguished from the ordinary gurnards by having the body completely encased in bony strongly keeled scales; for this reason they, with a few other genera having the same kind of armature, are often removed from the family Triglidæ, of which the gurnard is the type, and rank as a distinct family, which is named Cataphracti, or mailed gurnards. Flying gurnards are as destitute of the power of true FLIGHT as are the common flying fishes (Exocœtus) and several other animals to which the epithet is applied. They are comparatively large and heavy fish, often attaining a length of 18 inches. Only three species of flying gurnards are known. They agree generally in their distribution with the flying fishes, being abundant in the Mediterranean and the tropical seas. One species, *Dactylopterus volitans*, is common in the Mediterranean, as is also *Exocœtus exiliens*; another species, *Dactylopterus orientalis* (figured above), inhabits the seas of the warmer latitudes, as does also *Exocœtus volitans*.

FLYING LE'MUR. See GALEOPITHECUS.

FLYING LIZARD. See DRAGON.

FLYING PHALAN'GER (Petaurus), a genus of marsupials distinguished from the PHALANGERS (Phalangista) by the possession of a lateral membranous expansion of the skin between the fore and hind limbs, associated with a hairy non-prehensile tail. The flying phalangers, like several other animals to which the epithet "flying" is given, do not possess the power of true FLIGHT. The membrane acts like a parachute, supporting the animal in its long leaps from tree to tree. The tail is free; in one species, *Petaurus pygmæus*, it may be useful in flight, the hairs being regularly disposed in two rows on each side, like the barbs of a feather.

The flying phalangers, like the great majority of marsupials, are confined to the Australian region; they are inhabitants of Australia and New Guinea. They are nocturnal in their habits, remaining during the day concealed in the hollows of trees, especially gum-trees. They feeds on insects and leaves, and the honey of flowers. The typical dentition is—

$$I.\ \frac{6}{..};\quad \frac{1-1}{0-0};\ pm.\ \frac{3-3}{4-4},\ m.\ \frac{4-4}{4-4} = 40.$$

One species, *Petaurus pygmæus*, has only three true molars in each jaw on each side; hence it is often separated generically under the title Acrobata. The largest of the

Petaurus taguanoides.

flying phalangers is the species figured, *Petaurus taguanoides*. One of the best known is the Squirrel Flying Phalanger (*Petaurus sciureus*), the Sugar Squirrel of the colonists. This little animal, about 8 or 9 inches in length, is common throughout New South Wales. The fur is ash-coloured above and whitish underneath. A dark brown stripe extends from the muzzle to the root of the tail,

which is tufted and black at the tip. Four other species have been described. The Pigmy Flying Phalanger, (*Petaurus pygmæus*), the Opossum Mouse of the colonists of New South Wales, about the size of a mouse, is remarkable both for its dentition and its beautiful feather-like tail.

FLYING SQUID is the name given by sailors to species of the genus Ommastrephes, which is a genus of CUTTLE-FISH allied to the common SQUID (Loligo). They swim like other cuttle-fish backwards, by expelling forcibly water from their funnel. They move so swiftly and directly that they look like arrows shooting through the water. They frequently make leaps out of the water to such a height as to fall on board vessels.

The genus Ommastrephes is characterized by having the body very long and cylindrical, with extremely broad terminal fins; the arms have two rows of suckers with oblique, toothed rings; the tentacles are short, thick, and strong, not retractile, webbed at the slightly enlarged extremity, and having four rows of cups. The internal shell or "pen" is as long as the body, narrow, with three diverging ribs and a hollow conical apex. The Sagittated Calamaries as the species of this genus are often called, live in the open ocean, where they occur in large troops, and are found in all climates. They are nocturnal animals, appearing on the surface of the sea only after evening has closed in. They are greedily devoured by whales, dolphins, and pelagic birds.

The Common Flying Squid (*Ommastrephes sagittatus*) is extensively used as bait in the cod-fishery of Newfoundland. Indeed it is so attractive to this fish that it is said one-half of all the cod taken at Newfoundland is caught with it. It is exceedingly abundant at times off that coast, occurring in vast shoals.

FLYING SQUIRREL is a name given to certain species of SQUIRRELS (Sciuridæ), the epithet "flying" being applied loosely to denote the power of making leaps through the air by means of an extensible, parachute-like, lateral membrane. The membrane extends along the sides of the body, including the fore and hind limbs, as far as the wrists and heels, leaving the tail free. This latter organ is stretched out in flight to aid in steering the body; in a state of repose it is curved gracefully over the back. The flying squirrels are inhabitants of both hemispheres; in Australia they are replaced by the flying phalangers. They form two genera, Pteromys and Sciuropterus. The largest of the group is the Taguan (*Pteromys petaurista*), which is about 2 feet in length, exclusive of the tail, which is about equal in length to the body. This animal inhabits the forests of India, Malacca, and Siam. It is nocturnal in its habits, and feeds on fruits. It leaps from tree to tree with the greatest rapidity, but always finishes its flight at a lower level than that from which it started. Ten other species of the genus Pteromys are known from India and Eastern Asia. In the genus Sciuropterus the tail, instead of being rounded as in Pteromys, is flat and has its hairs arranged in two rows, like the barbs of a feather. This is very widely distributed, ranging from North America, through Northern Europe, to China and Japan. The European Flying Squirrel or Polatouche (*Sciuropterus volans*) is only found in the north-eastern parts of Europe, being more abundant in the forests and wild wastes of Siberia. Its habits are nocturnal. It feeds on nuts, berries, the buds and shoots of the birch and of other trees, such as pines and firs. The polatouche is about 6 inches in length, with a short broad tail. Its fur is tawny brown above, white below. It resembles the common squirrel in its habit of partial hibernation. The Assapan (*Sciuropterus volucella*) is one of the smallest species of flying squirrels. It is very abundant in the United States, infesting the prairies in large troops. In its habits it resembles the above species. Several other species have been described from India, Java, &c.

The name "flying squirrel" may also be extended to some animals closely resembling the flying squirrels in external appearance, but differing considerably in certain particulars. They form the genus Anomalurus, which has been removed from the family Sciuridæ, and made the type of a distinct family, Anomaluridæ. In the family Anomaluridæ the number of the ribs, twelve or thirteen in Sciuridæ, is increased to sixteen. The tail is long and hairy, and has large scales on its under surface near its root, which assist the animal in climbing. There is only one premolar in the upper jaw; the molar teeth are flat and not tuberculate. The lateral membrane is supported by a cartilaginous process arising from the elbow of the fore limb—not, as in the ordinary flying squirrel, from the wrist. Five species of the genus Anomalurus have been described, all from West Africa. As far as is known they resemble the flying squirrels in their habits.

FO or **FOHI** (pronounced by the natives Fŭh) is the name by which Buddha is worshipped in China. He is usually represented as being invested with light, and his hand concealed beneath his robe, as symbolic of the invisible exertion of his power. The doctrines of Fo are particularly propitious to every wish that can be formed in the human heart; and as they are not obstructed by any measures of the government, which allows perfect toleration, they are naturally popular among those classes of the people who are not satisfied with their prospects as resulting from natural causes. Judging from the number of images found in the temples of Fo, we may safely conclude that the religion, when practically viewed, is a pure system of idolatry. *Poo-tala*, or the grand temple of Fo, as described by Sir G. Staunton, had not less than 800 priests attached to it. Though there is no state religion in China, the great mass of the common people belong to the sect of Fo; and perhaps none are more superstitious. The temples are always open for those who choose to consult the decrees of heaven, and they return thanks when the oracle proves propitious to their wishes. "The religion of Fohi," says Sir G. Staunton, "professes the doctrine of transmigration of souls, and promises happiness to the people on conditions which were, no doubt, originally intended to consist in the performance of moral duties; but in lieu of which are too frequently substituted those of contributions towards the erection or repair of temples, the maintenance of priests, and a strict attention to particular observances. The neglect of these is announced as punishable by the souls of the defaulters passing into the bodies of the meanest animals, in whom the sufferings are to be proportioned to the transgressions committed in the human form."

The religion of Fo, though extending over the whole of China, and influencing more or less the mass of the people, is fast losing its hold on them, and has very little of the power and authority it once possessed. Its edifices are going to decay, and no new ones rise on their ruins. Its priests are illiterate, and together with their religion are held in contempt by the philosophic Chinaman, who generally espouses the system of Confucius.

FŒTUS, a Latin word applied to the immature young of any viviparous animals. There has been considerable confusion in the application of the names fœtus and embryo. The newly developed human germ is generally called the embryo during the first four months of utero-gestation or pregnancy, and then during the rest of its uterine life it is denominated the fœtus; but this distinction is entirely arbitrary. The word embryo is applied to the immature being, developed in the ovum of any animal after impregnation, and before it is capable of supporting an independent existence, and therefore is equally applicable to oviparous and viviparous animals; it has a much more extensive signification than fœtus, which is restricted to the embryo of viviparous animals only, in which the ovum after

impregnation descends from the ovary into a cavity denominated the uterus (womb), where it becomes attached to the mother, and derives its nourishment from her till it is sufficiently perfect to exist separately. In oviparous animals, on the contrary, the germ, when detached from the ovary, is conveyed through a tube called the oviduct, and excluded from the body of the mother, without being again connected with her, or deriving any nourishment from her. See EMBRYO.

A few remarks upon the human fœtus may be added to what is said under EMBRYO. When the embryo is first distinctly visible through the membranes it is not above a line in length, and is of an oblong shape. At the end of about six weeks it is slightly curved, and somewhat resembles a split pea; at the conclusion of the second month it may be compared in size and shape to a kidney bean. The extremities begin to shoot out like the buds of a plant in the sixth week; the arms are at first large in proportion to the legs; in fact the limbs are originally very much alike, and only distinguishable by their situation; they at first grow straight out from the trunk. At an early period of fœtal existence there is no brain, but only the spinal marrow, so that the embryo of man then resembles one of the lowest orders of animals; the brain is perceptible about the second month, and is evidently formed by a prolongation of the spinal cord. Before the sixth month the brain is semifluid. Hair does not grow on the head before the sixth month, and even then it is very short, thin, and light-coloured. The nails are at that period indistinct, the eyelids closed, and the pupil is filled up by a membrane. In the seventh month the membrana pupillaris is removed, the eyelids open, the nails become more distinct, and the hair longer and thicker. At the full time the nails are quite formed, the hair covers the head, and is of its proper colour, the cells of the skin are filled with fat, the lungs are large and red, the valve of the foramen ovale completely formed, the ductus arteriosus nearly an inch in length, and almost as large as the aorta itself.

The human fœtus has many peculiarities which distinguish it from the child after birth. The most characteristic difference is that it lives in a medium of water, and not of air, and consequently does not breathe by lungs. The blood which is deteriorated by circulating through the system is then purified in passing through the placenta. The position of the fœtus in the uterus is that which takes up the least room; it lies with the head downwards, the chin being bent on the breast; the knees are doubled up close to the belly, and the arms are folded in the space between the head and legs.

The ordinary period of utero-gestation in man is forty weeks, though labour often takes place before this period, or is delayed a little beyond it.

FOG (from the Danish *fyge*, to drift, as in *sneefog*, a snowstorm, &c.), is the name given to a heavy accumulation of visible watery vapour hanging near the surface of land or water. Slighter accumulations in the same position are termed mists; and fog differs from mist only in the circumstance that it is of larger extent and greater depth.

The precipitation of aqueous vapour in the atmosphere takes place whenever a saturated stratum of the atmosphere comes in contact with a stratum of a lower temperature, or with a portion of the surface of the earth by which it is cooled and rendered unable to retain in solution the same amount of vapour as before. Thus it commonly happens that when a current of water-laden air comes in contact with the cool side of a mountain or hill the moisture is condensed in the form of mist; and when cold mountain streams reach low and warm levels of the atmosphere they are often covered with mist, as the cold water condenses the vapour above them.

A similar result takes place when evaporation from a moist warm portion of the surface of the earth is received into a colder stratum of the atmosphere. This is frequently observed in connection with large rivers, lakes, and damp marshy districts. When water has acquired during the day a degree of temperature similar to that of the neighbouring land it generally remains warmer during the night. Hence it sends up a stream of vapour into the air above it, which may continue after the point of full saturation is reached, the vapour becoming condensed in the form of mist or fog; and a similar result is produced when the warm moist air lying over the surface of the water comes in contact with the cooler air of the land. A certain amount of rest in the atmosphere is necessary for the formation of mist, as when a brisk wind is blowing the watery vapour is swept away as quickly as it is formed, and the temperature of the air generally is also rendered more equal; but mist or fog already formed is often carried by a gentle breeze for a long distance from the place of its origin.

In rural districts and on the sea-coasts fogs generally consist of little else than watery vapour, and though occasionally of great density they are usually white. But in manufacturing districts and large towns the unconsumed carbon with which the air is laden becomes mingled with the vapour of the fog, giving it a yellow, brown, or even black appearance. It has been calculated that of the fuel burnt in the ordinary open household fireplaces, about 9 per cent. passes into the atmosphere in the form of smoke, and serves to form the cloud of "blacks" by which every surface in a large town is more or less coated. When the air is still and filled with mist these particles gather round them thin films of the vapour; and further, these mist spherules become coated with a kind of varnish or opaque pigment generated by the destructive distillation of coal. The latter point was elucidated by a series of interesting experiments carried on by Professor Frankland, and it was found to account also for the fact that dark fogs are often "dry" in their character, the atmosphere sometimes having only 50° of humidity and never reaching the point of saturation. Possibly these dark carbon-laden fogs are seen at their best (or worst) in London, where the vapours rising from the Thames or the exhalations of the Kentish and Essex marshes are combined with the contaminations yielded by the coal fires and gas flames of the metropolis, and also with the carbonic acid generated by nearly 4,000,000 human inhabitants, and innumerable hosts of the lower animals. In its worst form every district affected is plunged in obscurity, and the streets become more gloomy at midday than they are at the darkest midnight when fog is not present. Dark objects become invisible at a distance of a few yards, and at night the flames of the gas lamps disappear from sight at a distance of 120 or 150 feet. At such times almost all the senses have their share of trouble. Not only does a strange and worse than Cimmerian darkness hide familiar landmarks from the sight, but the taste and smell are offended by an unhallowed combination of flavours, and all things become greasy and clammy to the touch. It is generally believed that the extension of the metropolis is increasing the intensity of the disagreeable effects of its fogs, and inasmuch as a spell of fog is always attended with a rise in the death-rate for diseases of the throat and chest, the subject is one that calls for careful investigation on the part of scientific inquirers and sanitary reformers.

FOG'GIA, a town of Italy, and capital of a province of the same name, is situated in the plain of Puglia, 75 miles N.E. of Naples. It has spacious streets lined with modern houses, several handsome squares, a fine cathedral, and other churches, a beautiful theatre, library, botanic garden, museum, infirmary, and orphan hospital. The trade in wine, oil, wool, capers, corn, &c., is large; and there is an important annual fair, which lasts twelve days.

The name of Foggia is derived from its corn magazines, through the word *fosse*. These are very extensive; they

stretch under all the large streets and open squares, consisting of vaults lined with masonry and their orifices closed up with boards and earth.

The city appears to have been founded in the ninth century, and peopled from *Arpi* or *Argyripa*, an ancient city 4 miles distant, said to have been founded by Diomed, which surrendered to Hannibal after the battle of Cannæ, and of which some faint vestiges are still extant. Foggia was greatly enriched by the Swabian princes of Naples. It was sacked in 1268 by Charles of Anjou, who died there in 1286. It was nearly destroyed by the earthquake of 1731. The population in 1882 was 40,283.

FOG-SIGNALS, such audible warnings as are used on railways, on board ships, and on the sea-coasts during the prevalence of fog or mist, and when light signals are not effective. On railways small metal cases containing explosive material are placed on the rails by men told off for this duty, and the engine wheels passing over them cause them to explode with a noise calculated to announce the approach of a train at a considerable distance, or to stop it if desired. Such signals form part of the equipment of station masters and railway policemen, so that they may be enabled to stop passing trains in cases of obstruction or danger, and they are generally used outside stations during the prevalence of foggy weather.

On shipboard various means are employed, such as the blowing of a horn, the ringing of a bell, the beating of a drum or gong, the striking of the anchor with a hammer, the discharge of a gun, and on steamers the blowing of the steam whistle. The Admiralty have rules for the government of a fleet of men-of-war in thick weather, such as occasional firing or ringing of a bell to indicate what tack a ship is upon, &c.; but little has been done to enforce regulations for the use of merchant ships in foggy weather, owing probably to the difficulties that beset the question, so much depending upon individual precaution for the safety of a ship in crowded maritime highways. If a simple and effective code of signals could be brought into general use it would be a great boon to the mercantile marine, but though many suggestions have been made no system up to the present has obtained acceptance. Fog-signals from the shore are very desirable, especially on a dangerous coast, or where fogs frequently prevail for lengthened periods. Around the coasts of the United Kingdom fogs prevail only for about sixty days during the year; but for more than half the year fog is the normal condition of the Canadian and United States coasts, and shipmasters who cannot afford to be delayed by it take the risk of running on by the help of fog-signals, even in a crowded track. In the American coasting trade fog-signals have come to be as much relied upon as are lights and beacons here, and regular traders along the deasest shores are seldom behind time through the assistance thus afforded.

The wreck of the *Schiller*, during a fog in 1875, occasioned the loss of more than 300 lives. The wreck took place on rocks near the Scilly Islands. An official inquiry showed the British system of fog-signals to be extremely defective, and a long series of experiments were then carried out by Professor Tyndall on fog-signals—all involving more or less noise, and demonstrating that the noisiest is the best. It was found that bells, perhaps the oldest signals of the kind, cannot be at all so readily heard as the horn or whistle. The fog-whistle worked by a small steam engine is capable of giving a surprisingly loud and piercing shriek, but experience has shown that a hoarse low-pitched note is the best for carrying the sound furthest. Nearly all the light vessels around the English coast are supplied with gongs of Chinese manufacture, which are sounded by hand during foggy weather. Like bells, they cannot be depended on at any great distance.

Experiments with gunpowder were also carried out by Professor Tyndall in conjunction with the Trinity House and the authorities at Woolwich, and it was very soon found that a short 5½-inch howitzer, with a 3-lb. charge of powder, made a much louder report than an eighteen-pounder with the same weight of charge. Thereupon guns of different forms were constructed, and one among them, the invention of Major Maitland of the Royal Artillery, designed with a bell-shaped mouth, was proved to be the best in throwing the sound over the sea and not wasting it to rearward over the land. The gun is a breechloader and has a number of revolving chambers, which can be fired rapidly or slowly as required. It was also ascertained that fine-grained powder produced a louder report than coarse-grained; the shock imparted to the air being more rapid in the one case than in the other. The latter discovery was followed by experiments with gun-cotton, which explodes with still greater rapidity; and this was found to be still more effective. A compressed slab of gun-cotton weighing 1 lb., and fired in the focus of a cast-iron reflector, gave a sound that was heard at a distance of 13 miles, and larger charges fired at a great height have been heard at a distance of over 20 miles. It was found, however, that such charges could not readily be used near the lighthouses, as the vibration caused served to injure the machinery used for the lights. Later experiments have been in the direction of rocket firing, and the charge of gun-cotton has been arranged to explode at a great height in the air.

In England Dungeness Lighthouse, and that of St. Catherine's, Isle of Wight, with others, are provided with fog-horns worked by caloric engines; and at some few highly elevated points round the coast—such as Flamborough Head, Lundy Island, South Stack of Holyhead—fog-guns are provided.

FOIL is a very thin sheet of metal, intermediate in thickness between leaf and sheet metal. There are two distinct kinds of foil in common use—the tin-foil used for silvering looking-glasses, lining tea-caddies, and for conducting coatings of electrical apparatus, and other similar purposes; and the bright foil used by jewellers for backing real or artificial gems, and thereby increasing their brilliancy or modifying their colour. These latter foils are made of tin, copper, tinned copper, or silvered copper—the last for the best work. They are left white for imitative diamonds, but are coloured for imitative rubies, sapphires, &c. The best white foil is made by coating a plate of copper with a layer of silver, and then rolling it in the flatting-mill. The coloured foils are made by coating the white foil with coloured varnish. The principal colours used by artists are employed, mixed with mastic, spirit, and drying-oil, to form the coloured varnishes. The following are examples:—Amethyst foil, lake and Prussian blue finely ground in drying-oil: sapphire foil, Prussian blue and drying-oil; emerald foil, pale shellac, alcohol, and acetate of copper; ruby foil, lake, isinglass, and shellac; topaz foil, turmeric, annatto, and shellac. Foil is also the name of the blunted rapier used in practising fencing.

FOIX, GASTON DE (VISCOUNT DE BÉARN), surnamed *Phœbus* on account of his personal beauty, was born 1331. He was the third Gaston of the famous counts of Foix. His father died when he was twelve years old, leaving him under the guardianship of his mother. In the course of his varied and somewhat turbulent career we find him in 1345 making his first essay in arms against the English in Guienne; in 1349 marrying Agnes, daughter of Philip d'Evreux, king of Navarre; in 1356 arrested by the French king, John II., on suspicion of criminal intelligence with his brother-in-law, the new king of Navarre, Charles the Bad; then, on his release, serving in the French army in succession against the infidels in Prussia, against the Jacquerie in Meaux, and in Béarn, against the Count d'Armagnac, his personal enemy, whom he took prisoner. In 1380 Gaston took arms against Charles VI. of France, the successor of John II., for removing him from the government of

Languedoc, and only yielded on negotiation. In 1382 Gaston's son, while paying a visit to his mother, who had retired to Navarre, to the court of her brother Charles the Bad, received from that king (to whom crime was familiar) what he pretended was a bag of love-powder, which the king told him to conceal, at the same time informing him that the sprinkling of a small quantity of it upon any food his father might eat would have the effect of reconciling the count to his wife, who had long been at variance with him. On his return to his father the youth attempted the charm. The powder turned out to be a strong poison, and Gaston ordered his son to be arrested. The young prince, deceived but not guilty, refused all nourishment, and died in his prison. Gaston died of apoplexy in 1391. The portrait which Froissart has drawn of Gaston is one of the completest pictures of what a chivalrous and semi-independent prince was in the time of our Edward III.

FOLC-LAND or **FOLKLAND** was the surplus land of Britain left over and above that actually occupied by the English invaders. Each man's land, ultimately acknowledged and recorded as his, was called in consequence Boc-land or *Bookland*; the rest was the property of the state, and could only be alienated (even in part) by the national consent expressed through the witan. But towards the end of the Anglo-Saxon period the folc-land began to be regarded as under the special control of the crown—first the witan, then the king as representing the witan, then the king alone; such were the gradual steps of the change of authority over folc-land. But in becoming crown-land folc-land did not in any sense become the king's property. The king—perhaps Alfred the Great was the first to do so—made grants of folc land, and at the next witan called men to witness the grant. Folc-land was never given, but only granted for a special time, returning to the nation at the end of that time. Neither was it granted gratuitously, but always bore some sort of service. Sometimes the temporary owner of folc-land was subject to a certain tariff, fixed very low, at which the king was entitled to purchase food or cattle; sometimes other fines were leviable. Folc-land could only be converted into boc-land (private property) by a special charter of king and witan.

At the Norman conquest this valuable national possession became definitely crown-land, *terra regis* (the king's land). The king used its proceeds as a main part of the revenue of the crown. Under Stephen large grants were made to the barons to purchase their support, grants which Henry II., son of Stephen's opponent, carefully resumed in 1155 ("Select Charters," Stubbs, 128). A similar transaction took place under John, who in his dire need lavished in vain the crown-lands upon the barons; and again under his successor, the virtuous Earl of Pembroke, regent of the boy-king Henry III., these illegal grants were withdrawn (1217). What Pembroke had failed to regain for the nation the brave justiciary, Hubert de Burgh, did his best to recover in 1220. Under Edward the Great alienation of national land of course ceased: to that noble and just prince it would have been as abhorrent as any other species of theft. But his worthless son, Edward II., in the pursuance of his scheme of governing the kingdom, after the imperial Roman system, by creatures of his own instead of by the nobles, found no way of enriching these to the necessary point so easy as by the gift of crown-lands. This was one of the main points of grievance causing the appointment of the lords-ordainers, and in 1311 the first ordinances took back these gifts. Hitherto the folc-land (crown-land) had been steadily decreasing; but in the next century, during the Wars of the Roses, it received considerable additions by the constant outlawries and confiscations for treason both by Yorkists and Lancastrians. Still, as the barons had to be rewarded continually for their services, the land in the actual possession of the crown rather diminished than increased. It produced £5000 only under Henry VI.

The many forfeitures under Henry VII. raised the national lands to a higher amount than they had attained for centuries previously, and the dissolution of the monasteries by Henry VIII. flooded the national rent-roll. Here was a chance to have inaugurated a sound national finance. Unhappily the king threw it away, and lavished upon his courtiers and favourites almost all he had seized from the monks. In the civil wars a century later Charles I. sold crown-lands to whoever would purchase them. They formed almost his only means of raising money. And when the king's fortunes had fallen, the Parliament sold the rest. But a grave distinction eventually arose between the two sets of transactions; for while the Royal sales were held valid at the Restoration of 1660, the Parliamentary sales were declared void. The lands thus regained shared the fate of the monks' lands in the previous century: Charles II. used them only as providing splendid gifts to his abandoned court, and wasted what might have been a noble national estate. At the Revolution of 1688 it was found necessary by William III. to make large gifts of crown-land; and the roll was so much reduced that at the accession of Queen Anne in 1702, a statute passed on the subject specially forbade any further alienation of the crown-lands, permitting only leaseholds or grants for a term of years. Very little now remained, comparatively; and although 1715 and 1745 each brought its bloodstained crop of forfeitures from traitors' estates, George III. at his accession derived only £6000 from the whole crown property. He therefore surrendered it to the nation, and received a corresponding addition to his civil list. In 1810 the crown-lands were taken over by the department of the woods and forests, and have since been so well administered that they now produce on an average £390,000 a year. What land the sovereign now holds, beyond royal palaces, parks, &c., is simply private property like that of any subject. The crown-lands have returned to the point they started from in their long career of vicissitudes, and what small fragment of them is left is under the control of the modern analogue of the Anglo-Saxon witan, namely of Parliament. But the many chances of founding a great national property that have been one after the other thrown away cause every student of history to grieve in tracing the diminution of the once splendid folc-land of England.

FOLIATION is the term applied to the structure of a rock when its component minerals have crystallized in approximately parallel layers or folia. This structure is the result of a segregation of crystals in a dominant plane, which plane is generally that of original stratification, but may be that of cleavage or a plane of jointing. Foliated rocks frequently contain mica or minerals with a micaceous cleavage, the cleavage planes generally coinciding with the plane of foliation. Gneisses and schists, especially mica and chlorite schists, afford excellent examples of foliation.

FOLI'GNO (the ancient *Fulginium*), a town of Central Italy, in the province of Perugia, in the Val Spoletano, and on the Flaminian Way, 20 miles S.E. of Perugia, and 14 N. by W. of Spoleto, on the railway from Rome to Ancona. The population in 1882 was 22,905. The town is walled, but its ramparts and bastions now serve for public promenades. Its streets generally intersect each other at right angles. There are few public buildings worthy of notice. There are numerous paper-mills turned by the Topino; and the town has manufactures of woollen cloth, silks, parchment, and bleached wax, and a considerable trade in cattle. The vicinity abounds with vineyards and olive and mulberry plantations. The river Topino, on which Foligno stands, has some fine cascades at a short distance from the town, and there is a wonderful natural grotto adorned with beautiful stalactites. This city appears to have been anciently of some impor-

ance; it was considerably augmented on the destruction of the adjacent town of *Forum Flaminii* by the Lombards in 740.

FOLIO, a term derived from the Latin *in folio*, that is, paper folded in *leaves*, with one fold. It gives therefore the largest-sized page possible with the given size of sheet. The size of folio pages varies from the antiquarian folio (which is 26½ inches by 15½) to pott folio (6¼ × 7½). When books are numbered by openings instead of by pages, as many merchants' books, for instance, with debits on one page and credits on the other, they are said to be numbered in folio.

In law-copying, &c., seventy-two words are said to make a *folio*, and the work is priced and reckoned in this as a unit. In Parliamentary proceedings the folio is of ninety words.

FOLKESTONE, a bathing-place, seaport, parliamentary and municipal borough of England, in the county of Kent, is situated on the shore of the English Channel, opposite Boulogne, partly in a hollow between two cliffs, and partly on the west cliff, being 83 miles from London by the South-eastern Railway. The cliff on one side of the town is chalk, and on the other sandstone. Folkestone is now a fashionable resort for sea-bathing. Spacious streets and noble terraces have been erected in the place of narrow, steep, and winding lanes. A broad sea-wall and esplanade was completed in 1870. The parish church stands on the site of the old conventual church of the Priory of St. Eanswith, founded by Nigel de Mureville, 1095. This priory (for Benedictines) succeeded the Nunnery of St. Eanswith, originally established within the old castle by King Eadbald, whose daughter Eanswith was canonized, and became the head of the house. This was the first female religious house in England. Telford gave the first impetus to the little fishing village by his pier, 1809. The harbour was not capable of affording anchorage to many vessels, admitting only ships of from 10 to 12 feet draught at high water, but has been very considerably improved and extended by the South-eastern Railway Company; steam-packets ply daily between Folkestone and Boulogne, and considerable quantities of wine and other French produce are imported. The number of vessels registered as belonging to the port in 1885 was 20 (2000 tons). The entries and clearances each average 1100 (230,000 tons) per annum. The town forms part of the parliamentary borough of Hythe. The municipality consists of four aldermen and fifteen councillors, of whom one is mayor. Folkestone was the birthplace of Harvey, the discoverer of the circulation of the blood, to whom a statue was erected in 1881. The population of the town in 1881 was 15,561.

FOLK-ETYMOLOGY is the name given to a curious series of blunders in the formation of words, perhaps especially frequent in English. It arises from the tendency of common folk, when they find a part of a word which would appear to have some independent meaning of its own or some relation to another word, as if derived from it, to intensify this chance likeness by some slight alteration, and thus in the course of time to produce a spurious etymology on the surface. The fabric *ribbon* (really the Celtic word *ribin*) is often used as a waistband by girls; what more evident to those who know no Celtic that it is a "ribbed band?" Consequently we find the eighteenth century, a grand source of this particular error, spelling the word *riband* very carefully. What the "rib" meant when the ribbon was of smooth weaving they did not stop to inquire. To have got an excellent meaning for half the word was enough. So *cowslip*, evidently by folk-etymology cow's lip (though nothing like a lip except in the sound), and so altered from *cowslyppe*, a later form of *cow-sloppe*, which meant quite a different matter to the early English farmer. *Lanthorn* for *lantern*, because lanterns had horn sides; *bridegroom* for *bridegoom* (the bride's man, *guma* being man), because for the time he is, as it were, the bride's servant; *Jerusalem* artichoke for *girasol* or sunflower artichoke, simply because the words were alike; *sovereign* for *sovran*, because a sovran reigns; *frontispiece* for *frontispice* (the page which looks towards the front or title page), as if it had to do with "piece;" *island* for *eyland* (*ey* being the Saxon for an island, as in Anglesey, &c.), as if it were derived from *isle*, the worn-down English version of the Latin *insula*; *pea-jacket* for the Dutch *pije* (a rough coat), neither "pea" nor "jacket" having anything to do with it; *penthouse* for *pentice* (*appendicium*, an addition, or lean-to), the "house" quite imaginary; *Birdcage* Walk for *Bocage* Walk (Bocage — shrubbery); *pickaxe* for *pikois*, which has nothing to do with "axe." Such are a few of the odd attempts of the English nation at folk-etymology. The public-house signs *Goat and Compasses* (God encompasses us), *Bag o' Nails* (Bacchanals), &c., yield another equally curious crop of oddities.

FOLK-LORE, as a special study, is essentially a production of modern times. The word was coined to express those traditional tales and customs which pass current among the mass of all nations apart from written literature. The term was suggested by Mr. Thoms in 1846. The study has now assumed the status of an acknowledged science, and from the nature of the subject and the discoveries possible to its students, it may be considered one of the most fascinating. If the folk-lore of a nation could be completely traced in its every aspect and to its earliest source, it would carry us back centuries in our knowledge of prehistoric man. One of the great results considered to have been attained by this science is that a connection has been proved between the Teutons, the Celts, and the Hindus as branches of one race originating in the central plain of Asia.

An extensive literature has sprung up dealing with folk-lore, among the works on which may be mentioned Max Müller's "Lectures on the Science of Language" and "Chips from a German Workshop," and also Fiske's "Myths and Myth-makers."

FOLK-MOTE or **FOLK-MOOT** (literally a meeting of the people), under the Anglo-Saxon government a general assembly of the people for considering and ordering matters of the commonwealth. The laws of King Edward the Confessor expressly direct that the meeting of the Folk-mote should be held once in the year, upon the 1st of May. The national assembly was by shires in general, and therefore became identical with the shire-mote (*scir-gemote*). See SHIRE-MOTE, COUNTY COURT.

FOND DU LAC, a city of the United States, in Wisconsin, situated on a rising-ground at the southern end of Lake Winnebago, 63 miles N.W. of Milwaukee. It has a considerable trade in timber and agricultural produce, and possesses several foundries, saw-mills, cigar factories, a tannery, and a railway factory. The prosperity of the town dates from 1845. Population in 1880, 13,805.

FONDI (the ancient *Fundi*), a town of Italy, in the province of Caserta, in a plain at the foot of the Roman Sub-Apennines, 12 miles N.W. of Gaeta. It is traversed by the Appian Way, which is well preserved, and forms its main street. It has a Gothic cathedral, and a trade in wine, olives, and citrons. Population, 7520. Between the town and the sea is the Lake of Fondi, the ancient *Lacus Fundanus*.

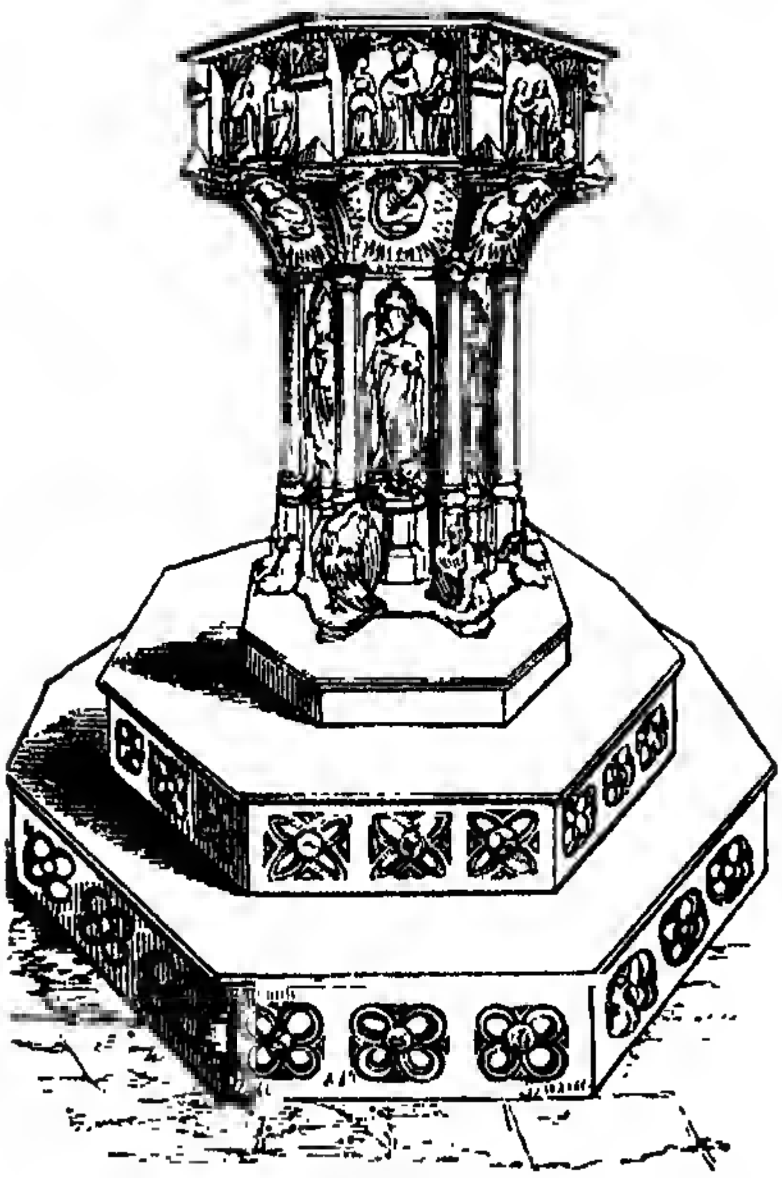
The neighbourhood is abundantly fertile in every kind of produce. This, in fact, is the *Cæcubus ager*, anciently so famous for its wine—

> "Cæcubam et prælo domitam Caleno
> Tu bibes uvam."— Hor. i. Od. 20.

(See also ii. Od. 14; and Martial, xiii. Ep. 15.) But, like the town, the wine has sadly degenerated, and is now quite unworthy the encomiums lavished on its ancient growths.

FONT, a vessel employed in Protestant churches to hold water for the purpose of baptism, and in Catholic churches used also for holy water. The form of the font is usually hexagonal, similar to the form of the baptistery, in which fonts were originally placed. Fonts also occur both of a circular and square form. They are usually shaped like a cup, with a solid stem, or supported on columns; the top is hollowed out for the water, and the sides and stem are often highly enriched with ornaments, sculptured figures, and with colour and gilding. In many instances a flight of steps forms a base, and even the sides of these steps are carved with panels, having quatrefoils and rosettes sunk within them. It was usual to cover the basin of the font with a wooden lid, and there are some of these remaining of a pyramidal or spire-like form, richly carved and designed, with a profusion of shafts, buttresses, and tracery piled up to the apex.

Among the fonts especially worthy of note may be mentioned those of Porchester Church, which is like the circular stone mouth of the well in the atrium of a Roman



Font in East Dereham Church, Norfolk.

house; of Lincoln Cathedral, which is square, on 5 columns, one being in the centre; Lowestoft in Suffolk, and Loddon in Norfolk, both remarkable for their richness of decoration; of Winchester Cathedral, very curious and ancient; and of East Dereham, in Norfolk, of which a representation is given above.

FONTAINE, JEAN DE LA. See La Fontaine.

FONTAINEBLEAU, a town in the French department of Seine-et-Marne, 36 miles S. by E. from Paris, near the banks of the Seine. It had 9734 inhabitants in 1881. It stands in the midst of the forest of Fontainebleau, and is well built, with handsome, wide, and straight streets. The town has a college, two fine cavalry barracks, and other remarkable edifices, among which are the Château d'Eau, containing a reservoir fed by a spring, the waters of which supply the fountains and basins of the palace (*Fontaine belle eau*); the hospitals founded by Anne of Austria and Madame Montespan; the public baths and library. Near the south entrance to the town there is an obelisk, erected in 1786 to commemorate the birth of the children of Queen Marie Antoinette. The palace is an irregular pile, resembling a group of distinct edifices rather than one united building. It has six courtyards, each of which is nearly or quite surrounded with buildings. This famous palace may be said to owe its origin to Francis I., though a royal residence had existed here since 1141. The works left incomplete by Francis were continued till the time of Louis XIV., in whose reign the whole was completed. After the first revolution it was occupied by the military school afterwards transferred to St. Cyr, and continued in a state of neglect and disrepair till it was completely restored by Napoleon I. to its original splendour and destination as a royal residence. From his downfall the palace was neglected and almost forgotten till after 1830, when it was restored by the munificence of Louis Philippe.

The palace of Fontainebleau has been the scene of several remarkable events. It was the residence of Christina of Sweden in 1657, and here she caused Monaldeschi to be murdered, or—regarded from her view—executed; the revocation of the Edict of Nantes was signed here in 1685; and here, in the following year, the great Condé died. The table at which Napoleon signed his abdication in 1814 is still shown in a salon of the Cour Ovale. The town, which was one of the favourite residences of Napoleon III., was occupied by the Germans in the war of 1870–71.

The park and gardens are in a style of magnificence corresponding to that of the palace; they are adorned with a cascade and canal (nearly three quarters of a mile long, and above 120 feet wide), with several smaller canals, a variety of jets d'eau, and with statues in bronze and marble.

The forest of Fontainebleau contains 40,620 acres, or nearly 64 square miles; it surrounds on nearly every side the plain in which the town stands; its surface is unequal, and its soil sandy, interspersed with blocks of granite, which are quarried for the pavements of Paris. It is pierced by a great number of fine avenues, and presents much picturesque beauty. It contains a great quantity of game.

FONTA'NA, DOMENI'CO, a distinguished Italian architect and engineer, was born on the borders of the Lake of Como in 1543. He is chiefly famous in connection with the removal of Egyptian obelisks in Rome. Sixtus V. was very desirous to re-erect the various obelisks that lay neglected among the ruins of ancient Rome, and especially to remove the one then standing in the Vatican Circus to the area in front of St. Peter's. This was above 83 feet high, and the ablest mathematicians and engineers were summoned to suggest the means. Among the 500 projects submitted, Fontana's was ultimately adopted with entire success. A very interesting account of all the circumstances was published by Fontana. He removed other obelisks subsequently, and one of a still larger size (above 105 feet high), with the same satisfactory result. Fontana had the charge of the Lateran Church, to which he made a new kind of portico, and immediately adjoining he built the palace of the Lateran, &c. He constructed the Vatican Library, and in so doing destroyed the noble court formed by Bramante. The next pope, Clement VIII., dismissed Fontana from the office of papal architect, when he was immediately invited to Naples by the viceroy, Count de Miranda, for whom he erected a royal palace and other works. He died at Naples in 1607.

FONTENELLE (the literary pseudonym assumed by Bernard le Bovier), born at Rouen on the 11th of February, 1657, was by his mother's side nephew of Corneille. He was educated at the College of the Jesuits in his native city. Here the law was the study to which his attention was nominally directed. Having lost the first cause in which he was retained, he left for ever the distasteful profession of the law, and devoted himself to literature.

Fontenelle cannot be called a genius, but he certainly was a man of consummate talent. He tried the vein of his uncles the Corneilles, but his dramas were failures;

Racine, Boileau, La Bruyère, and Rousseau all made him the butt of their keenest satire, in epigrams which survive as models of causticity to this day. But Fontenelle bravely turned to another career; leaving the drama he took to a peculiar semi-classical affected kind of writing, afterwards called *Marivaudage*, from the name of his most famous pupil; and he also wrote in simple and unaffected prose some clever Dialogues of the Dead, after Lucian's model. These "Dialogues des Morts," published in 1683, first laid the foundation of his literary fame, which was firmly established by the appearance two years afterwards of the "Entrétiens sur la Pluralité des Mondes," one of the ablest of his works, and exhibiting a rare combination of popularized science and wit. The object of the latter was to familiarize his countrymen with the Cartesian astronomy. In the "Éloges" which, as secretary of the Academy, he pronounced upon its deceased members, he combines history and encomium with such tact and delicacy that the panegyric is almost imperceptible, and the commendation the highest when apparently least intended. His other chief works are the "Histoire des Oracles," the "Géométrie de l'Infini," and the "Apologie des Tourbillons." By applying ordinary language to the most abstruse topics he contributed greatly to advance a spirit of scientific research.

Fontenelle's poetical works occasionally display much delicacy of sentiment, and extreme polish and elegance both in the thought and diction; but generally the poetic feeling is weak, and there is little invention, and a decided want of originality and force. "Isméne" and the "Apologie de l'Amour," however, are likely to live.

From 1699 to 1741 he held the distinguished and responsible office of secretary to the Academy of Sciences at Paris. Fontenelle died at Paris on the 9th January, 1757, having completed his hundredth year within a few weeks, and expired exclaiming, "Je ne souffre pas, mes amis; mais je sens une certaine difficulté d'être." The calmness with which he met his death was in keeping with the serenity of his whole life, which presented a rare instance of self-command and moderation, neither confounding virtue with austerity, nor pleasure with excess.

FONTENOY, an inconsiderable village of Belgium, in the province of Hainault, 4 miles S.E. of Tournay, is historically famous for the great battle fought there 11th May, 1745, between the French under Marshal Saxe, and the allied English, Austrians, and Dutch, commanded by the Duke of Cumberland. The contest was obstinate and severe. At one time victory seemed to have declared in favour of the allies, and if the English had been properly supported by the Dutch such would probably have been the case. In the end, however, the French were victorious. "Les Anglais," says Voltaire, "se rallièrent, mais ils cédèrent; ils quittèrent le champ de bataille sans tumulte, sans confusion, et furent vaincus avec honneur" ("Siècle de Louis XV." chap. 15). The allies lost about 7000 men killed and wounded, and 2000 prisoners, on this occasion. The loss of the French amounted to nearly 6000 killed and wounded.

FONTEVRAULT, a town of France, in the department of Maine-et-Loire, situated 9 miles from Saumur. It has a population of 1571. The town owes its existence to the famous Abbey of Fontevrault founded in 1099, of which the great church, a magnificent monument of the twelfth century, and all the other buildings now remaining, have been converted into a central prison. The abbey possesses great interest for an Englishman, as it contains the cemetery of the Norman kings and the counts of Anjou. The tombs of Henry II. and his queen Eleanor of Guienne, of Cœur-de-Lion, and Elizabeth the queen of John, are the only ones which have been saved from utter destruction.

FOO-CHOO-FOO or **FUH-CHOW**, an important city of China, the capital of the province of Fookien, one of the five places named in the treaty of 1842 where British subjects were allowed to reside and trade. It is situated in lat. 26° N., lon. 119° 25′ E., about 35 miles from the sea, and is about 10 miles in circumference, the suburbs being as extensive as the city itself. The population is estimated at 600,000 within the walls and 400,000 in the suburbs. It is regularly fortified in the Chinese fashion, and the streets and shops are of a very superior character. The neighbourhood of Foo-choo-foo is celebrated for the manufacture of china-ware, and 500 ovens may be seen constantly at work. No place in China can produce such admirable specimens of ware. The wood used in burning it is brought upwards of 300 miles. The cotton of Foo-choo-foo is particularly good, and the brilliancy of its blue dye is proverbial. About 70 miles from the city is the central depot of the great black tea or Bohea hills, whence the tea can be sent down to the ship's side in four days. The commerce of Foo-choo-foo is steadily increasing, the place being the great port of China for that kind of Congou most consumed in Great Britain. The imports of foreign merchandise, however, are comparatively unimportant, there being very few native merchants of any means in the place. Nearly all the tea trade is done through agents in Foo-choo-foo, who act for the proprietors. The imports are therefore confined to a few cotton and piece goods, opium, and lead for tea-chests. In 1856 only eighty-three vessels, of 20,000 tons, entered the port, while the number is now about 400 per annum. The annual imports are valued at about £1,000,000—four-fifths being British—and the exports at over £1,000,000. The latter consist almost entirely of tea, of which between 80,000,000 and 100,000,000 lbs. are shipped—four-fifths of the whole quantity being sent to Great Britain and her colonies. The town is known locally as Hokchin.

FOOD. All organized bodies are nourished by the introduction into their internal structures of materials from without. Such materials are called indifferently aliments or food, and are fitted to supply and maintain the fluid and solid matter of the body. For this purpose they must either be soluble naturally, or capable of being dissolved by the digestive principle of the stomach. They are distinguished from medicines by the fact that while the latter only modify vital action the former in nearly all cases supply the material which sustains such action. The exceptions are those foods which, either non-nutritive or but slightly so in themselves, yet are valuable in aiding the nutritive powers of others. They may be called food-adjuncts. However diversified the articles employed may be in external appearance or chemical composition, they are reduced by the action of the organs of digestion into a fluid (chyle) of homogeneous character, which is reconverted into solids and fluids of different natures by the influence of the powers of assimilation. See DIGESTION.

Although man derives his food from both the vegetable and animal kingdoms, yet as the animals which are consumed by man derive their nourishment from the vegetable kingdom, plants are the true source of most of the food both of man and the lower animals. The principal constituents of the human body as well as all other animal bodies are the organic elements, carbon, hydrogen, oxygen, and nitrogen, and it is the waste of these substances which is constantly going on that it is the object of food to supply. Plants do not supply these constituents in a simple form, but as secretions of the vegetable tissues known to chemists as gluten, fibrin, albumen, casein, &c. The temperature of the human body in health is 98° Fahr., and not only has food to build up the fabric of the human body, and to supply the daily waste of tissue which is going on, but also to keep up this animal heat within the system.

Liebig taught that the waste of the muscular system was the source of muscular power; that is to say, that the

muscles were disintegrated in use, and required constant renewal by nitrogenous or flesh-forming food, such as the flesh of other animals, or the nitrogenous compounds contained abundantly in wheat, and more sparingly in barley, oats, rye, and the pulses. He taught that the animal and vegetable fats, with the several forms of starch and kindred substances which contain no nitrogen, could not build up the tissues, but served by their oxidation to produce heat and hence force. Thus man has been compared to a steam-engine, he being a machine for obtaining force from food, as that is a machine for obtaining force from fuel. The muscles, on this analogy, are like the piston-rods and other metal parts of the engine. They are the means by which the force is applied or brought to bear; and although they do suffer waste and disintegration, they suffer slowly, and are not themselves sources of power. This is supplied by the combustion of fat or starch, as in the engine by the combustion of fuel. But these views, though they have been most valuable in stimulating research, are far too exclusively chemical to be of any real physiological value. First, to destroy the time-honoured but worse than useless "steam-engine" analogy. It serves as an illustration well enough, but no more; for what engine burns its own substance as fuel? An engine's motor power is supplied from without, and so much fuel as is supplied so much heat does the furnace give; stop the supply and the engine stops too. But not so with the body; the production of its heat is the result of its work, instead of (as in the engine) the cause of its work; and so far from stopping when the supply is stopped, the body works rather better after the food has entirely disappeared as food, and has become absorbed among the liquids and solids of the body, than under an immediate supply, as just after a hearty meal.

Though probably all accounts of human fasting beyond, at the utmost, three months are impostures (water of course even in this case being freely allowed), yet some of the lower animals exist without food for extraordinary periods. Latreille found a spider alive four months after he had placed it in his collection. Baker kept a stag-beetle without food three years, and it flew away when released. Rudolphi kept a proteus five years. Anecdotes of frogs and toads existing still longer without food abound. When the continual waste of the tissues makes itself felt by the sensation of hunger—apparently a local feeling of the stomach, but by no means due to the stomach merely, this organ merely providing a seat for the manifestation—then a fresh supply of food must if possible be provided. If not, the body is like a spendthrift, and exhausts its substance. But it is not the food which is burnt, it is the tissues which burn, if burning we may call it.

Next as to the classification of foods. It is imperatively necessary to call attention to the uselessness of Liebig's classification, because even in some recent manuals, otherwise excellent, such as those of Drs. Smith and Church, the whole question is vitiated by being dealt with from this standpoint. The chemist forgets that he is dealing with living tissues, and reckons up his percentages as if his materials were safely isolated in glass retorts. Not so the greatest teachers of this all-important subject; those whose most representative work is perhaps the remarkable "Physiology" of Professor Michael Foster (London, 1879). These latter prefer rather to study the actual effects of food in the living body than to invent theories, however brilliant as generalizations, to account for what *may* be the causes of the effects they acknowledge. If the chemical view were correct a food would either be invariably to all ages and under all conditions nutritive or non-nutritive. Salt is always saline, hydrogen always burns, nitrogen always extinguishes, &c. Not so foods. "One man's meat is another man's poison" is a proverb perfectly true, as every reader will admit. Only rigid martinets or thoughtless parents condemn children to abstain from the coveted "sweetstuff," or force them to swallow the loathed fat or the "wholesome" pudding (which is indeed truly wholesome to the elders themselves); for they now know that nature, in our great ignorance of the subject, is a better guide than a diagram or a chemical analysis. The flesh of the ox and of the tiger is chemically the same; one would therefore theoretically suppose the same food would serve both at a pinch. Yet the ox eats the grass, and would starve in a slaughter-house; while the tiger eats the ox, but perishes in the most fruitful fields. We must all admit the superior closeness of tissue and concentration of food in a beefsteak over a cabbage, yet a rabbit starves upon the first and grows fat upon the second, because the one is assimilable by his organs and the other is not. There are men probably in the circle of every reader who cannot eat cheese, and others butter, or again eggs; some are half poisoned with strawberries; others have actually died (as the Abbé de Villedieu) from being over-persuaded to eat meat, from which for years they had abstained, warned by their own instinctive repulsion against the food.

But further, while it is thus shown to be impossible to test a food as to its nutritive power otherwise than by actually eating it, digesting it, and working upon it, it is also easy to show that the division into flesh-formers and heat-producers is delusive, if intended to be an accurate logical division. For firstly, not a cell, not a fibre can be formed, nor can subsist when formed, without a certain amount of fat and salts; and as to water, it forms 70 per cent. of the whole body, 75 per cent. of the muscles, 80 per cent. of the nerves, 83 of the lungs, &c. In muscle, beyond the 75 parts of water, there are 4½ parts of fat and about 21 of other solids. In brain, with 76 parts of water, 14 parts of fat to only 10 parts of albumen exist. Why, then, should we deny to water and fat the epithet of flesh-formers? Liebig would consider them as accessories, limiting the essentiality of the formation of flesh to *proteids* or nitrogenous foods, *i.e.* substances containing nitrogen as well as carbon, hydrogen, and oxygen. Yet we find that a man dies in a few days if water is withheld, but can live weeks without proteids; and also that if pure proteids, as albumen, fibrin, &c., be supplied he starves rapidly. Majendie ("Report of the Gelatine Commission," 1841) fed dogs successfully on 300 grammes of raw meat daily, but they starved at once on even 1000 grammes of fibrin and gelatine. We know that wheat contains only 2·3 per cent. of nitrogen, whereas beans contain 5·5 per cent.—yet who would compare beans with wheat as a flesh-former? Gelatine, richer than blood or muscle in nitrogen, has no nutritive value at all when used alone. Space forbids further illustration of the absurdity of forming any physiological theory of foods on so manifestly insecure a basis; and the division must be (as it now is by the best authors on the subject) relegated to its proper service as a useful classification merely.

Turning to the other view, that fats and starches serve only the function of heat-producers, we are met by a crowd of equally absurd results. The Hindu eats his rice under a tropical sun, and if in addition to this "heat-making" food he is rich enough to drink melted butter by the cupful he is only too glad to do so. The fruits of Italy are by Liebig contrasted with the blubber-oil of the Arctic regions; but a merely cursory examination shows the Italian as eating far more oil than the Swede, and comparing not badly with the Eskimo. Even the most unobservant traveller is forced to note the greasy cookery of the south, for it often offends his northern habits. Why, then, single out fats and starches as heat-producers, since people in hot countries eat more of them than those in temperate climes? The truth is that in colder countries greater exertion is necessary to keep warm, and greater waste entails greater food supply: now fats last the longest,

are less easily decomposed in the system than any other food; and of the other foods, proteids are easier digested (in the largest sense of that word) than starches, so that it is at once accounted for that rice, flesh, and tallow form an ascending scale rising with the latitude, from the Hindu to the European and to the Eskimo.

On the other hand, we must not only regard non-nitrogenous foods as flesh-formers, but we find we must regard the nitrogenous proteids as heat-producers. Urea is the great means of excretion of nitrogen; indeed practically it may be taken as the only means. It is found that a liberal diet of lean meat given to a half-starved dog by no means results in the laying on of flesh alone. The greater part of the nitrogen of the food is found by the experiments of Pettenkofer and Voit to come away in the urea of the urine and fæces; very little is retained. As the animal increases in strength more and more nitrogen is excreted, till at last a nitrogenous balance is obtained, and just as much nitrogen is excreted as is absorbed. Thus the effect of nitrogenous food is to increase the nitrogenous metabolism (or the "give and take" of nitrogen) of the body. This nitrogenous balance gained the animal grows fat, and we therefore are irresistibly drawn to the conclusion that the nitrogenous food splits up, part passing off as urea, part chemically recombining and turning from proteids to fats. We may even go so far, on the strength of recent experiments, as to suspect that the pancreatic juice is the agent of this new chemical combination and change of nature. In the experiments of Lewis and Gilbert also this fact is clearly brought out, for they found in fattening pigs that for every 100 parts of fat in the food the pigs laid on 472 parts, the enormous excess being due to the metamorphosis of the other elements. It would seem, therefore, that the function of proteids is in the nature of a ferment or provocative of metabolism. The different behaviour of proteids and fats on this score is remarkable; for whereas increase of proteids in the food causes increase of nitrogen in the excreta, increase of fats in the food causes a very slight increase of carbon in the excreta: much fat is retained. In fact, in the case of the pigs above, 21 per cent. of the fat of the food was permanently retained.

The sum of the matter is that pure proteids, just as pure fats or starches, are insufficient to form flesh or sustain life; but since no food is purely proteid, while many are pure fats or starches, food of a partly proteid nature—that is, the so-called nitrogenous foods—will support life and form muscle, while fats and starches will not. Thus, although it is imperative to throw aside the dogma that nitrogen is any more necessary than any other element of food, yet it is clear that a classification of foods into nitrogenous and non-nitrogenous serves valuable uses. Before quitting the general consideration of foods, the action of fats and starches upon proteid metabolism must be mentioned. This is found to be very great in preventive power, as would be anticipated. Nitrogenous equilibrium is attained with considerably less expenditure of proteid food. Thus with a diet of 800 parts of lean meat and 150 parts of fat and starchy food the nitrogen of the excreta equalled that of the food, whereas no less than 1800 parts of lean meat would have been necessary to obtain the like result. On the contrary, increase of proteid foods causes increased metabolism not only of proteids, as above mentioned, but of fats and starches as well. This is the philosophy lying at the root of that system of reducing obesity known from one of its advocates as "Banting's diet." Increasing the nitrogenous elements he causes waste of the non-nitrogenous by the metabolism induced by the proteids, and at the same time he reduces the supply of the fatty and starchy foods so that the waste is not repaired.

Nothing is more common than the delusion (for it is a pure delusion) that the food is directly assimilated by the body. The sugar we eat is not the sugar of the body, the fat of the food is not the fat of the body, nor do the proteids of the food become those of the body. Even, as we have seen, we are unable to say the nitrogenous elements supply the nitrogenous tissues, since it is shown above that proteids often become fats in the body, and it is also known that the bulk of the carbonic acid excreted is derived from the metabolism of the nitrogenous tissues. Food is in fact food, not partly prepared tissue: it is absorbed as material to be decomposed and built up afresh in perfectly new combinations. When we speak of a nitrogenous balance we mean that certain nitrogen is taken into the body, and certain *other* nitrogen, equal in amount, is thrust out; so also when we speak of the fat being "retained," what we mean is that a certain quantity of fat being absorbed, a certain quantity of *other* fat, less in amount, is thrust out. These remarks apply to digested food, because the proviso must be made that frequently food passes through the alimentary canal unchanged—that is to say, has never in a true sense entered the body at all, any more than if it had been taken into the mouth and spat out again. Cases of this are rife in overfeeding, or in disorders of the alimentary canal.

It is necessary just to mention another exploded theory: namely, that animals depend on plants for their supply of organic materials, the plants existing by working these up from the soil out of inorganic materials; for animals do themselves also thus convert inorganic into organic substances, and plants cannot exist without large organic elements to feed upon. A plant condemned to feed on inorganic substances alone would die. (This is why we supply it with manure, &c.) But conversely, an animal condemned to feed on organic substances alone also dies. Take salt, for example; and see how the cattle follow the traveller in the Alps for miles to lick his hand for the sake of the perspiration, or gather in eager groups around him if they discover he has a lump of salt in his pocket. Withhold salt from man, and he perishes miserably. The salt need not be taken *as salt;* it may be that the food is cooked in salt water or has salt juices, &c.

In constructing a dietary, due allowance being first made for the digestibility of the foods as well as their chemical composition, and special care being taken of individual peculiarities, we have to consider the facts set forth above.

As to proteids we note that their characteristic feature is active change; they are costly, even extravagant, in their action. The great symptom of gout is an undue presence of uric acid; that is, an over-use of proteids. Too great use of meat and such highly nitrogenous food throws a great strain upon the system to get rid of the nitrogenous crystalline bodies thus produced as excreta.

As for the fats and starches, and the fatty and starchy parts of "nitrogenous" foods, these are the main ultimate sources of energy and of heat in the body. Further, they are economical as foods. They resist the wearing change of the over-activity of the ferment-like nitrogenous portions. They are much more easily stored up in the body than the proteids, and of them the fats excel the starches. For fattening processes these elements must be well in excess in the food, but to maintain the body in great muscular energy the proportion must be less.

Water and the saline parts of food need but little care in a dietary; for the appetite of thirst soon calls for a supply of the first in a manner not to be denied, and ordinary foods contain sufficient of the latter. The superiority of fresh meat and fresh vegetables as diet is due to the large proportion of salts of various kinds they still retain. But of course, as before said, they are just as indispensable foods as either of the great divisions previously mentioned. Finally, the air is a food of the highest importance.

In addition to the foods proper there are the food adjuncts. These are those stimulants, those condiments, and those flavours which, while doubtful if they are themselves foods, are

of the greatest possible use in assisting the action of food. Beer is to some extent a food, and so is cocoa, but the nutritive parts of such articles are not the parts now under consideration. Taking them in order we may remark of the stimulants that, contrary to the usual belief, founded upon the mere bodily sensation (a local effect on the skin similar to that which makes us feel cold in winter and hot in summer, while all the time the heat of the body is invariable), alcohol in any form lowers the temperature of the body, and lessens the respiratory changes. Its use therefore is not without danger, and to many persons it is highly injurious. Others easily habituate themselves to its moderate consumption. To none is it a necessity. The lessened vitality of the body causes food to last longer, and alcoholic drinks are therefore said truly to save food. The drunkard eats very scantily. The use of tobacco follows much the line of that of alcoholic drinks. Tea and coffee excite the respiratory powers, on the other hand, and are true stimulants. Condiments spur the organ of taste up to increased activity, so that the food is more delicious, its flavour being fully perceived, perhaps some slight chemical action even being induced to assist; and also they cause the saliva to flow freely, and thus the gastric juice—for the latter follows the former in a curiously close manner. They therefore promote digestion if moderately and properly used. Some, as salt, are true foods as well as condiments. The aroma and other flavours of delicate food act in this way as a subtle condiment, and greatly add to its digestibility. Hot meat is therefore considerably easier of digestion than the comparatively flavourless cold meat. The Duke of Wellington died through a rather heavy meal of cold meat which at his advanced age, though his hunger had made it welcome, the organs could not digest.

Bringing the elements of foods under their main heads we find we get the following:—*Nitrogenous:* fibrin, albumen, casein, the albuminoids, gelatine, chondrin, cartilage, &c. (contain nitrogen, carbon, hydrogen, oxygen, and sulphur); *non-nitrogenous:* fats, carbohydrates, as starch, sugar, &c., also cellulose, gum, &c. (contain carbon, hydrogen, and oxygen); *water* (hydrogen and oxygen) and *air* (oxygen and nitrogen); *mineral matters*, as chloride of sodium (salt), phosphate and carbonate of lime, iron, phosphate of magnesia, several sulphates, salts of potash, silica, &c.; *alcohol*, as spirits, wine, beer, &c.; *condiments*, as mustard, pepper, spices, &c.; *acids*, as in fruit, &c., vinegar, &c.; *alkaloids*, as in the active principles of tea, coffee, cocoa, and of tobacco. The average daily proportion of these elements was found by actual experiment by Ranke to be for himself, when in good health and neither gaining nor losing weight (74 kilogrammes), as follows:—

Nitrogenous (proteids),	100
Fats,	100
Starches and sugar,	240
Water,	2600
Salts,	25

Upon comparing many experiments the following has been arrived at as a fair average for a man of medium stature weighing 11 stone (154 lbs.):—

Nitrogenous,	8·9
Fats,	8·0
Starches and sugar,	10·7
Water,	81·5
Salt (chloride of sodium),	·7
Other salts, phosphates, &c.,	·2
	100·0

This would be realized by 18 oz. of bread and 1 oz. of butter; 2 oz. of bacon, 8 of potatoes, and 6 of greens; 8½ oz. of cheese; ⅝ oz. of salt; 4 oz. of milk and 1 of sugar; 66½ oz. of fluid, as water, tea, beer, &c.

Every important food has an article to itself; an enumeration of such articles would therefore be superfluous. We shall elsewhere (VEGETARIANISM) discuss more fully the extreme views of those who, from different motives, maintain either that we *can* or that we *ought* (two very different positions) to do without meat altogether. It seems as if, in truth, advocating an entirely vegetarian diet for all mankind in these days is waste of time. It is very desirable to know that certain vegetable foods, or combinations of vegetable foods, contain as much strength-producing material as beef or mutton at half the cost, and the sooner and the oftener this is preached into the minds of the working classes the better; but there is one inherent weakness in the creed of vegetarians, and that is that they cannot get on without animal food—namely, milk and eggs. Of course the fact stares vegetarians in the face that nature has provided animal food for all young mammals, and that is a very awkward and untoward fact. Vegetarians, however, in the face of it, have thought it wise to include milk as an article of vegetarian diet. But milk cannot be got without cows, and as the consumption of milk may be expected to increase, and is said as a matter of fact to increase, where little or no other animal food is taken, the number of cattle must be expected to increase under a vegetarian *régime*, and to cover the whole surface of the globe in time if they are not killed; but one of the great arguments for vegetarianism is the cruelty of killing animals. Nobody, of course, desires that any animal shall be killed but with the minimum of cruelty; but it would seem that if the vegetarian yields on the subject of milk, he must also yield on the subject of killing animals, and if animals must be killed, it is difficult to see why they should not be eaten, seeing that there is no doubt they make excellent food.

The question of the "preservation" of food is one which is becoming of increasing importance, owing to the strong tendency to a decrease in the number of cattle in the United Kingdom. This fact, coupled with the prevalence of foot-and-mouth disease, makes the prospect of meat consumers of limited means anything but a pleasant one; and as the price of butcher's meat continues to rise it is but natural that the question should be one of great interest as to whether there is any reasonable prospect of the superabundance of sheep and oxen being brought to this country, either in a live or dead state, from our colonies or other countries, so that what appears to be the necessary consumption of animal food among us may not be seriously checked. Numerous attempts have been made to bring over to the United Kingdom in a fresh state the meat so plentiful in Australia, South America, &c., the processes employed being (1) dessication, or drying; (2) refrigeration, or the application of cold; (3) the use of chemical agents, or antiseptics. It would appear, however, that though each of these methods have been found to answer to a certain extent, only the second has succeeded in giving any profit to the undertaking. The most usual method which has enabled importers to place preserved food on the market with any certainty of profit is that of preservation in air-tight tins. Meat, fruit, or any kind of food may in this way be preserved for almost any length of time and in any climate, and is found to be both wholesome and palatable. It has also the merit of cheapness; but a somewhat unreasonable prejudice against it leads most people to prefer paying the higher price for butcher's meat, now imported alive from various parts of the Continent in large and increasing quantities.

With the view of providing a comparatively inexpensive substitute for so costly an article of diet as fresh meat, various "extracts" have of late years been produced, the best known being that of the celebrated Baron Liebig. Until this manufacture commenced myriads of cattle in South America were slaughtered merely for the sake of

their hides and tallow. Such a waste of valuable food was greatly to be regretted, and its utilization by means of "extract" commended itself both to the philanthropist and the political economist. But it is found that the extract cannot take rank as an article of diet, being in itself not sufficient as a food, but simply a very useful tonic and aid to digestion.

The expense of the proteid foods has been spoken of; and this, which to each generation appears so especially crushing, has, we find upon examination, been the case from the earliest times nevertheless. Premising that the value of money was then out of all proportion with its present value, the following proclamation of Edward II., issued in 1315, is yet very surprising to read:—

"Edwarde, by the grace of God, Kynge, &c. To Shiriffes, Mayors, Bailiffes of Fraunchises, greeting. Forasmuch as we have heard and understanded the greevous complayntes of Archbishops, Bishops, Prelates, and Barons, touching great dearth of victuals in our Realme: we ordeyne from henceforth that no Oxe stalled or corne fedde be sold for more than xxiiis. No other grasse-fed Oxe for more than xvis.; a fat stalled Cowe at xiis.; another Cowe lesse woorth at xs.; a fat Mutton corne fedd or whose wool is well growen at xxd.; another fat Mutton shorne at xiiiid.; a fat Hogge of 2 yeres olde at iiis. iiiid.; a fat Goose at iid. ob (2½d.); a fat Hen at id., in the Citie at id. ob (1½d.); foure Pigions id., in the Citie three Pigions id. ob. Item, xxiiii Egges a peny, in the Citie xx Egges a peny we ordeyne to our Shiriffes." A hen for a penny, and twenty-four eggs for the same price, seem certainly not dear even for the "peny" of Edward II.

Great light has of late years been thrown upon the question of the relative value of various kinds of food by the valuable "Food Collection" of the Department of Science and Art at South Kensington. A very useful handbook of the collection is published, which gives in a form convenient for reference or study the most important facts known about foods. The handbook was revised by Dr. Church in 1876–77. Food, and the best manner of cooking it, also forms a very prominent subject now taught in schools. The manual on Food in the International Scientific Series, by Dr. Edw. Smith (London, 1880), is also very valuable, though far too exclusively chemical in its consideration of the nutritive value of foods, as is also Dr. Church's handbook spoken of above. Sir Henry Thompson produced a useful epitome of recent views on "Food and Feeding" in 1880; and perhaps the best popular statement of the vegetarian position is that by Professor Francis W. Newman, "Essay on Diet" (London, 1883). The physiological view of food is best given in the fine work on "Physiology" by Professor Michael Foster. A very interesting, though speculative, treatment of the subject is contained in G. H. Lewes' "Physiology."

FOOD ADULTERATION. A select committee of the House of Commons, which investigated this subject in 1871, clearly proved the necessity for an Act to repress adulteration. The system was not confined to one class of articles alone, for according to the evidence of numerous scientific witnesses, poisonous matters were largely used for colouring and flavouring in confectionery; mustard was adulterated with turmeric and other substances, and chicory with Venetian red, carrots, and treacle; beer and gin were extensively adulterated; rice and alum were used with flour in the making of bread; drugs were largely adulterated; and there was a regular trade in diseased meat.

A very salutary check was placed upon many of these practices by the Adulteration Act of 1872, but a more comprehensive measure was passed in 1875, known as the Sale of Food and Drugs Act. Its chief provisions will be found described under ADULTERATION. Since April, 1876, all tea consumed in the United Kingdom must (under the Act of 1875) have passed the scrutiny of customs officers specially appointed for its examination and analysis.

FOOLS, FEAST OF, a travesty in whole or in part of the ceremonies of the church, which arose in very early times out of the desire of the church to incorporate into Christian usage all the festivals of paganism. The SATURNALIA, elsewhere described, occurred just before midwinter, and afforded the slaves of the ancient world a brief time of unbounded license. This became in Christian dress the Feast of Fools, and it lasted down to the Reformation and later. Different countries and places celebrated the feast differently. In Scotland the Abbot of Unreason was elected (see Sir Walter Scott's "Abbot" for a capital delineation of the ceremonies indulged in); elsewhere a Boy-bishop, or a Lord of Misrule, or a Pope of Fools played his brief part as noisily and mischievously as he could. Part of their work was the performance of a mock mass; and that too, frequently, in the church itself. This last custom survived in the south of Europe till the middle of the seventeenth century. Elsewhere, especially at the Feast of the Circumcision (1st January), the priests themselves made a donkey take part in the service, which was then called the Feast of Asses, and an ancient hymn still exists, used upon the occasion, with the refrain "Hé, Sire Ane, Hé!" Sometimes the ass was held to allude to the nativity or the Palm Sunday procession, at other times to the ass of Balaam.

FOOL'S PARSLEY. See ÆTHUSA.

FOOLS'CAP, a size of paper 17 inches by 13½, so called from having been specially preferred by the learned society of the Granelleschi in Venice (1740). Their device being a fool's cap and bells it was used as the watermark in their paper, and thus gave its name to the size. This is the usual derivation of the term; but it seems perhaps likely that the English term mixed up the Italian *folio-capo*, folio sheet, with the design of the Granelleschi, and by a happy folk-etymology translated *folio-capo* into fool's cap, because occasionally that device was seen on large-sized paper.

FOOT and **ANKLE.** The human foot and ankle, bearing the whole weight of the body upon a small surface, and yet beautifully mobile in spite of so much strength, present together one of the most beautiful contrivances of nature. Here we have the outcome of generations upon generations of development, the fish's fin, the turtle's paddle, the lizard's foot, succeeded by the beautiful structures which bear aloft the quadrupeds, and the still more wonderful quadrumanous extremities culminating in that which naturally occurs to us as the type of a foot (though really it is least of all a type, as it is the flower and fruit of all the rest), the foot of the only erect animal in the world, man. After examining the foot of man with the help of a carefully drawn plate, it will be possible to make clear the principal foot-constructions in the animal kingdom.

The foot of man, then, consists of three parts, the tarsus and metatarsus, and the toes. The first two of these, respectively *a b c d e f g* and *h h* of figs. 1 and 2 in the Plate, form an arch upon which the whole weight of the body rests; and the third part, the toes, *i i* in the same figures, cling to the ground, and thus serve to steady the body when it is at rest in an upright posture. The toes also serve in progression as a fixed point of resistance for the muscles by which the leg is bent forwards upon the foot, the first effort in bringing the body forward.

The leg-bones of the lower leg are two in number—the *tibia* or shin-bone, and the *fibula* or splint-bone, the latter articulated with the former at the knee, and then separating from it in its course to rejoin it again at the ankle. In figs. 3 and 4 the large somewhat triangular section of the tibia and the smaller section of the fibula are seen. The main weight of the body is borne by the tibia, but the fibula also articulates with the foot, both bones moving by

a hinge-joint upon the astragalus, the uppermost bone of the foot, and both bones sending down a process to guard the ankle joint on each side. The tibia forms in this way the inner ankle and the fibula the outer ankle, and the astragalus is thus completely locked in.

Passing now to a more complete examination we find that the foot has twenty-six bones, of which seven go to the tarsus, five to the metatarsus, and three each to the toes, all but the great toe, which has only two.

The seven bones of the tarsus are of very diverse shape. The first is the *astragalus* or knuckle-bone (fig. 5, and also figs. 1, 2, *a*), and as has been said is that by which the leg and the foot are connected, as it carries the convex lower surface of the ankle joint (*a*, fig. 5) and the concave surfaces (*b*), one on each side to receive the ankles. The scaphoid bone articulates at *c*. The second bone of the tarsus is the largest bone of the foot, namely, the heel (figs. 1, 2, *b*, and fig. 6). This is irregularly rhomboidal in figure, with a deep hollow on the inner side caused by the overhanging of the two joint surfaces *a b*, fig. 6, for the astragalus. Through this large hollow all the flexing tendons, the muscles, vessels, and nerves pass safely into the sole of the foot free from danger by pressure. The heel joins the cuboid bone by its surface *c*, and *d* is the great projecting tuberosity extending far behind the ankle joint, and giving so marked a character to the foot. It is this projection of the heel which affords sufficient base for the support of the body, as well as a powerful lever by means of which the extending muscles are able to raise the hind part of the foot, and therefore, if the foot be fixed by the toes grasping the ground, to elevate the whole body upon the foot. It must be specially noticed that man is the only animal whose heel touches the ground, for this at once gives a marked distinction above all other creatures. The remaining bones of the tarsus are usually grouped together as the *instep*. They are the navicular (ship-like) or scaphoid (boat-like) bone, so called from its peculiar shape (figs. 1, 2, *c*, and separately fig. 7). It receives the astragalus in the hollow *b*, fig. 7, and the cuneiforms on the rounded surface *a*. These latter (fig. 8) are roughly wedge-shape (Lat. *cuneus*, a wedge) in form, and are three in number. Their position in the foot is best seen at *d e f*, figs. 1, 2. The other bone of the tarsus is the cuboid (fig. 9), which ranks in the foot alongside the cuneiforms, but articulates with the heel, not the scaphoid, as shown in fig. 1, *g*, and which derives its name from resembling roughly a flattened cube. Its under surface is grooved deeply, as will be observed; this is to allow of the passage of an important tendon which assists materially in supporting the transverse arch of the foot.

The metatarsus (figs. 1, 2, *h h*, and fig. 10) has one bone for each toe, and extends between the lower tarsal bones and the phalanges of the toes. The metatarsal bones are irregularly cylindrical, with flattened joint surfaces at their bases, *d d*, fig. 10, and rounded at their heads, *e e*, where they receive the first row of toe-bones. Three of them are distinguished from the rest, and are figured, each in two aspects; *a* is the metatarsal bone for the great toe, thickest and strongest of all; *b* is the second metatarsal bone, longest and slenderest of all; *c* is the bone for the little toe, with a projection beyond the outer edge *f*, well seen in fig. 1 to the left. These bones connect by a sort of dovetail or double mortise-and-tenon joint with the tarsal bones. The long and slender bone *b* penetrates deep among the cuneiform bones, and on the other hand the middle bone, next it, is so much shorter as to allow the cuneiform bone at *f*, fig. 1, to extend somewhat downwards into the metatarsus.

The toes (figs. 1, 2, *i i*, and fig. 11) consist of fourteen bones disposed in three rows or phalanges, *b c*, fig. 11, depicted in the Plate under two aspects. The great toe, *a*, has only two rows, but the bones are so large that these two more than equal the three of most of the other toes in length. The two first rows have a cup at one end and a ball at the other for articulation; the last row has a terminal expansion to support the nails. The great toe (*hallux*) is anatomically *pollex pedis*, the thumb of the foot; it is, or can be made, very mobile. When the body progresses its whole weight at every step is thrown upon the ball of the great toe. The junction of the metatarsal bones with the toes is of such a nature as not only to permit the up and down motions of flexion and extension, but a sideway motion of separation also, so that the toes can be spread. This is often well seen in infants, but the habit of wearing boots soon reduces or destroys the power.

The ankle joint is protected and surrounded by a capsular ligament, and its parts are tied together by the peroneo-tarsal ligaments (fig. 4, *a b*). *a* tying the outer ankle to the astragalus, *b* to the heel; and also by the tibio-tarsal ligament (fig. 3, *c*), tying the inner ankle to the astragalus, scaphoid, and heel-bone at once, and thus binding the tarsus itself together. This last is also further aided by the plantar ligaments, inner and outer, whereof the inner one is shown at *d*, fig. 3.

The muscles moving the foot are chiefly situated in the leg below the knee, and the principal ones are the following:—In fig. 12, at *s*, is the *tibialis anticus*, passing to the great toe and bending the foot upon the leg, at the same time twisting the foot outwards a little; at *t* is the *extensor longus digitorum pedis*, arising from the whole front edge of the fibula and ending in the four toes by four tendons—it bends the toes, and, if the action continue still farther, the foot upwards (the *extensor brevis* is shown in fig. 15, *r*); at *u* is the *extensor proprius pollicis*, whose tendon runs across the instep inwards, along to the upper surface of the great toe—it extends the great toe upon the foot; at *w x* are the *peroneal* muscles, serving to rotate the foot inwards, but the long peroneus also aids to uphold the arch of the foot, its tendons acting as an elastic sling upon which the middle of the foot rests. In fig. 13 we see the great *gastrocnemius* muscle of the calf, *y**, in two great masses separated by a seam, uniting to form the powerful tendon Achilles (*tendo Achillis*), which, as shown in the figure, is inserted into the heel. This muscle is the great antagonist of those which bend the foot upon the leg, and those which extend the leg upon the thigh. It thus bears a great part of the weight of the body, and indeed can raise the whole body if the toes remain fixed on the ground so that they serve as a fulcrum. It is also shown at *y* in fig. 12. The *plantaris* muscle, *z*, fig. 13, is remarkable as having the largest tendon in the body; this tendon passes down between the two divisions of the gastrocnemius and is inserted into the inner side of the heel-bone. It helps to raise the heel, and it turns the inside of the heel upwards. Fig. 14 shows the deeper muscles of the calf. The *tibialis posticus* is at *b*, serving to extend the foot upon the leg, and to support the arch of the foot. Its tendon enters the groove at the back of the inner ankle, whence it passes into the foot close to the tarsal arch, to be inserted by several distinct slips into the inner surfaces of all the tarsal bones except the heel. The *flexor longus digitorum pedis perforans* is shown at *a*. When its tendon reaches the ankle joint it crosses behind it, and entering the sinuosity of the heel bone is continued to the middle of the sole of the foot, dividing then into four slender tendons. This division is well shown in fig. 17, where *c* is the accessory flexor, a short assisting muscle. The use of the long flexor of the toes is to bend the toes towards the sole of the foot, and by consequence to make the foot bite the ground. Returning to fig. 14, we see at *d* the long flexor of the great toe (*flexor longus pollicis*), a very powerful muscle. The tendon curves round the heel and passes above that of the long flexor of the other four toes, as is very clear in fig. 17. It bends the great toe

powerfully, and causes it to touch the ground first, so that the whole weight of the body as it rises in walking is borne upon the fixed point afforded by the great toe. It also assists the other long flexor to support the arch of the foot, for as they enter the sole from opposite sides and cross one another, their pressure keeps the bones together and prevents the foot from splaying outwards. The sling thus formed, though very valuable, is not so perfect as that given by the anterior tibial and long peroneal muscles, as already described.

Besides the accessory flexor (fig. 17, *c*) there are several small muscles in the sole of the foot bending the toes from side to side, such as the *abductor* and the *short flexor* of the great toe (fig. 18, *f*, *g*), and the abductor and short flexor of the little toe (*h i*); and there is also the perforated short flexor of the toes (*e*), which has its tendons perforated to let pass the tendons of the long flexor described above—these perforations are clearly shown in the Plate near the extremity of the toes. Fig. 19 shows at *k* the *adductor* of the great toe, antagonist of the abductor above named, the first drawing the toe to the foot, the second separating it. The transversal muscle, drawing together the whole of the metatarsal bones when in action, is shown at *j*.

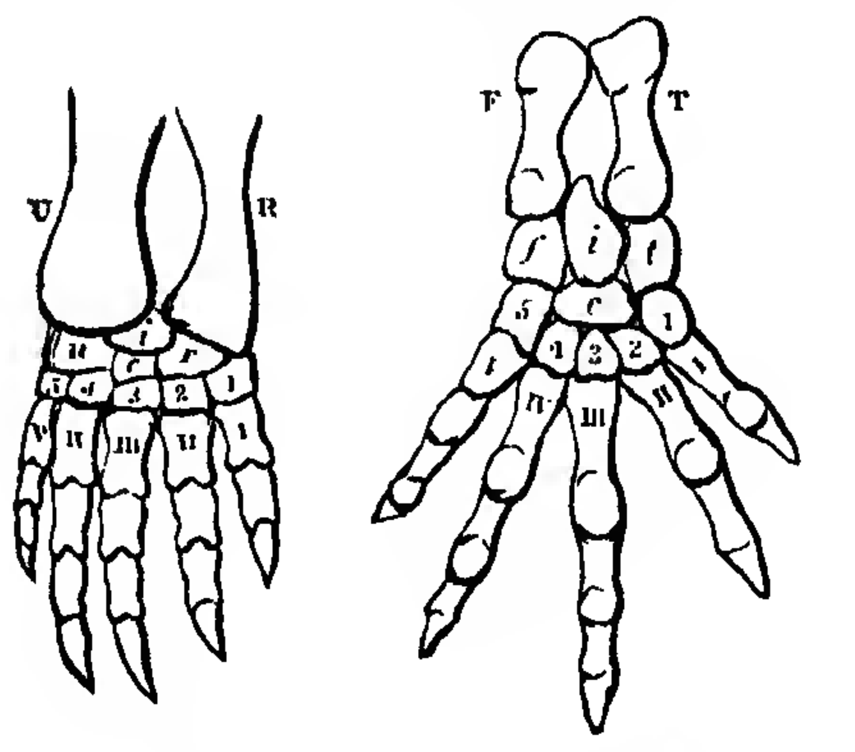
All these muscles and tendons of the sole are not seen until the large tendinous expansion called the *plantar fascia* is removed. The plantar fascia extends from the heel to the inner ends of the toes, and is composed of fibres which as a rule run in the direction of the foot. It is thickest in the middle, filling up the bony arch of the foot, and providing a soft springy surface whereon to tread.

Before tracing the development of the foot throughout the subkingdom of the Vertebrata it should be made clear what a foot is. It was formerly usual, following Cuvier, to group the apes and monkeys as *quadrumana* or four-handed animals, as opposed to the great bulk of the Vertebrata (except the birds), which are four-footed animals. But this entirely depends upon our granting that an opposable great toe must be a thumb, otherwise the classification falls to the ground as misleading. But the opposability of the thumb is only one manual characteristic, and that not the chief one, though the most striking. Indeed it is only our long civilization which has injured the mobility of the great toe. Where it is preserved and cultivated it can be made of great service. The Chinese can row with it, the Egyptian can carve and "turn" with it (the hands causing the turned work to rotate by a drill-bow), the Indian weaves with it. Further, if the opposability of the thumb be what constitutes a hand, the American monkeys have no hands, nor have the spider monkeys, where the thumb is a mere rudiment, &c.

But when we compare the articulation of the great toe with that of the thumb [see HAND], and when we see that the carpus of the hand is formed of two rows of four bones each, while the tarsus of the foot has only one such row, the three (not four) remaining bones not being in a row at all, but one (the heel) projecting behind the rest, and another (the astragalus) being piled up on top as the keystone of the arch of the foot, we see that there is a fundamental difference in the bony framework of the two. Further, the long muscles of the fingers, which lie in the forearm and send down their tendons to bend the fingers, keep these tendons separate, whereas the long muscles of the toes, lying in the calf and sending down their tendons into the sole of the foot to bend the toes, have these tendons united and commingled in a remarkable manner, and the united tendons receive a short accessory muscle arising from the heel-bone, to which anything resembling it in the hand is quite unknown. The foot has also (and the hand is without) a short extensor muscle of the toe lying on the dorsal or upper side. Finally, the peronæus longus, with its peculiar crossing of the tendon across the sole of the foot, is distinctly and remarkably characteristic of the foot alone.

When, therefore, we examine the hinder extremity of a gorilla, for example, and find the same arrangement of the upper bones of the tarsus as in man's foot, and the same three peculiarities in the muscles, we do not hesitate an instant to declare it a true foot, although it is a prehensile foot, and serves the purposes of a hand.

But there seems little reason to doubt the fact that hands and feet, or anterior and posterior extremities, have gradually become differentiated, and that originally they had the same form. Professor Huxley has pointed out ("Anatomy of Vertebrates," London, 1882) that the anterior extremity of some Chelonia and the posterior extremity of some Amphibia present identical elements, and probably are survivals of the original type which served for both. This probable primitive type of *manus* (Lat., hand, *i.e.* anterior extremity) and *pes* (Lat., foot, *i.e.* posterior extremity) is, as may be supposed, but rarely now to be found. Each animal form has modified the type for its own requirements. Thus in the tarsus of man's foot the astragalus represents the coalesced tibiale and intermedium, the heel-bone is the fibulare, and the scaphoid the centrale; the three cuneiforms are the 1, 2, 3 of the



Right fore foot of Chelydra (after Huxley). Right hind foot of Salamandra.

U, Ulna; R, radius; F, fibula; T, tibia *u*, Ulnare; *i*, intermedium; *r*, radiale; *c*, centrale. *f*, Fibulare; *i*, intermedium; *t*, tibiale; *c*, centrale 1 The pollex and the hallux respectively, the figures being placed on the metatarsal bone; II. III. IV. V. the other digits and metatarsals.

distal row of the primitive tarsus, and the cuboid is the coalesced pair 4 and 5.

In only one case, that of the fossil fish-lizard, the Ichthyosaurus, are there more than five digits. These creatures boasted an extraordinary number of bones in each digit; and an extra row of supplementary bones on each side, fringing the pes, as it were. Both in this group and in the contemporary Plesiosaurus, as well as in the fossil and existing turtles, whales, and (in a less degree) the seals, the digits are bound together and cased in a common sheath of integument, and so form paddles. Little or no individual motion is retained by the bones. In other mammalian vertebrates than man and the apes, the number of digits of the foot does not reach the typical number of five; thus pigs have four, the rhinoceros three, the ruminants (cows, sheep, &c.) two, and the horse one.

Rapidly running through the Vertebrata above the fish, we find the frogs (Amphibia) with long hind legs, the tibia and fibula fused into one bone. The tarsus has two long cylindrical bones, representing the astragalus and the heel-bone respectively; the distal series of the tarsus is reduced. Both frogs and newts have five toes, but only four fingers.

Next, the Reptiles, of which the crocodile is the highest

type, never have fewer digits than three in the hind foot (*pes*), and the metatarsal bones are not ankylosed (immovably united), characters distinguishing their feet from those of birds. The latter, however, present so many affinities with reptiles that Professor Huxley unites them in one "province" of Sauropsida. In both reptiles and birds the ankle joint is between the divisions of the tarsus, not between the tarsus and the leg. In birds the astragalus sends up a process on to the front face of the tibia, with which it ankyloses, and the foot (which never contains more than four digits) has one metatarsal bone shortened and incomplete, and the others ankylosed. The extinct Dinosauria occupied a middle position, resembling birds as to the astragalus and the reduction of the number of digits, and reptiles as to the rest. The paddles of Ichthyosaurus, Plesiosaurus, and the turtles have been mentioned. The lizards usually have the full five digits on the pes, the fifth one sticking out (like a thumb on the wrong side of the hand); and the number of bones in the toes, starting from what corresponds to our great toe, is 2, 3, 4, 5, 4 respectively—a peculiarly lacertilian type. The numbers in the digits of the manus (fore foot) are 2, 3, 4, 5, 3. The same arrangement is found in the gigantic extinct fossil lizard called Protosaurus. The foot of the chameleon varies as to the digital bones (2, 3, 4, 4, 3), but still more as to the tarsus, which consists of four bones only, two of which are articulated to the tibia and fibula respectively, a third follows below and between them, and a fourth succeeds that; to the last the phalanges of the toes are all articulated. The toes form, too, equal and opposable pairs, and thus grasp small branches with great firmness. The next order, Snakes, has no hind limbs, except a few dim traces in some species. In the crocodiles we first find a heel, giving a very marked character to the hind feet of this reptile. The fore feet have five, the hind feet only four digits; and only the three inner digits in each case have claws.

The foot of Birds is much more than the mere digits which are commonly taken to represent it. What is usually called the leg of the bird is in reality the metatarsus and the distal part of the tarsus ankylosed into one "tarso-metatarsus" bone, the remainder of the tarsus being indistinguishably amalgamated with the tibia, and the ankle joint (vulgarly taken for the knee) being between the two parts of the tarsus thus divided. The hallux (great toe) has two phalanges, and is usually directed backwards, and is united to the tarsus by ligament only, and three toes forwards, respectively possessing three, four, and five phalanges: one toe is wanting. The ostrich has only two toes (the third and fourth); no wild bird has more than four. By counting the phalanges we can tell which digit, if any, is suppressed, as they always keep the numbers 2, 3, 4, 5 respectively. Parrots, cuckoos, and woodpeckers divide the foot equally (like chameleons), two toes backwards and two forwards. Owls can turn the outer toe outward or even backward at will. Swifts, on the other hand, have all four toes directed forwards. Swimming birds usually have either a rudimentary hallux or none at all. Other three-toed birds are the emu, cassowary, and bustard. During sleep the toes of birds are mechanically flexed by the action of a special muscle which runs from the pubis outside the knee to join one of the flexors of the toes; and which is therefore put upon the stretch whenever the leg is bent upon the thigh. The web connecting the toes of swimming birds, and the large development of "leg" (tarso-metatarsus, part of the true foot, as explained above) in the wading birds, storks, herons, &c., and the spur which projects from the tarsus in the scratching birds, as the common fowl, &c., and which may be developed, as in the game-cock, into a formidable weapon of offence, are all well-known varieties of feet among birds.

In Mammals the foot (*pes*) normally consists of five toes and five metatarsal bones. So is it with marsupials. However, in the ruminants there are but two metatarsals, separate in the young but ankylosed in the adult, and these carry two toes. In the horses the suppression is carried still farther, for there is but one metatarsal and one toe. In the lions, tigers, cats, and dogs, while the manus (fore foot) has five digits, the pes (hind foot) has but four. In all of them what seems to be the knee is really the heel, and the bones of the knee-joint are really the bones of the tarsus; what seems to be the leg is anatomically the metatarsus, and what seems to be the foot is but the toes of the foot.

The feet of the sloths (Edentata) are very remarkable. The Ai, or three-toed sloth, has three toes to each foot, and these are short, completely rigid, and so enveloped in the integument as to leave nothing visible but the enormously long and crooked claws by which the creature swings hanging downward from the boughs of trees. Other species have two toes to the manus, three to the pes. All the sloths have the feet set askew on to the leg, so that not the sole but the edge of the foot touches the ground; and as, in addition to this, the hind limbs are comparatively very short, the animal finds great difficulty in getting along the ground, though it is wonderfully agile in its proper region —the boughs of trees.

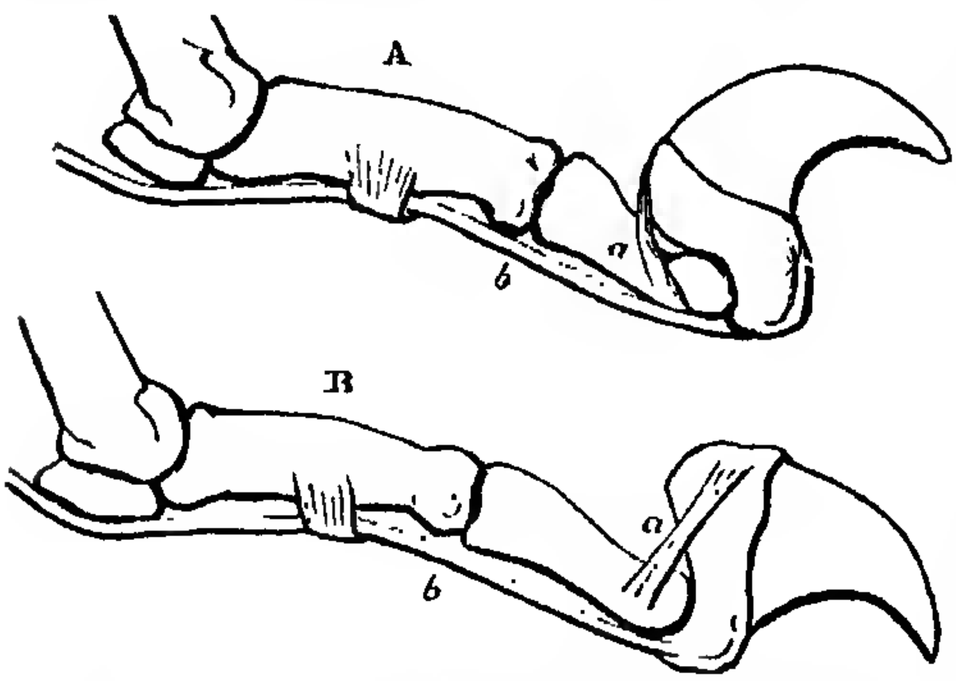
The Ungulata or hoofed animals (ruminants) are classified by their number of digits, the horse and ass (1), the tapir and the rhinoceros (3), &c., with an odd number of toes, being called the odd-toed division (Perissodactyla), and the ox (2) and pig (4), &c., the even-toed division (Artiodactyla). But fossil Equidæ (horse-types) are found showing that the present one-toed animal is the result of great variation. The oldest fossil horse is the Eohippus (Eocene strata), with five toes in the manus (counting the rudimentary pollex as one) and three toes in the pes. Then we get the Orohippus (Eocene) with four and three toes respectively, about the size of a fox. Then the Miohippus, Anchitherium, and others (Miocene), with three toes in both feet, about the size of a sheep. Then in the Hipparion (Pliocene) the middle toe is alone useful, the others being shortened; and in the Pliohippus these others sink into mere splint bones, to disappear altogether in the fossils of the uppermost strata and in their successors the horses of to-day. The nail of the toe or toes spreads out into a hoof of considerable size, whole in the horse, divided in the ox, sheep, and pig: so that the animal is really walking on tiptoe, touching the ground with its nail and not approaching it with its foot at all.

The Carnivora are also divisible by the characters of their feet. The pinnigrades (fin footed) are those which, as the seals and walruses, have the feet webbed and projecting but slightly from the body, so as to serve rather for swimming paddles than feet. The hind feet of the seal are placed very far back in the axis of the body, one on each side of the very short tail; so that the animal appears at first sight to have a cleft tail instead of two feet. The plantigrades (flat-footed) are the bears, &c., who walk upon the whole of the foot, the sole resting on the ground. The digitigrades are the lions, tigers, cats, and dogs, who all walk upon the toes, the heel being raised considerably from the ground. The elephants also walk on their toes, but behind the toes are great elastic cushions in which they are embedded, and which unite to form a large flat integumentary sole touching the ground. Though the elephants have five toes to each foot, the fore feet of the Indian elephant have five nails and the hind feet but four, while the African elephant has only four and three respectively.

The digitigrades (lions, cats, &c.), have a remarkable arrangement for protruding their claws for action, and sheathing them when they are not wanted, so as to keep them from wounding unnecessarily, and also to keep them sharp and unblunted. All the members of this family have very soft padded feet, can all alight easily and softly

from a considerable leap, mostly spring upon their prey, and can move in a remarkably noiseless, stealthy manner when approaching it.

Of the feet of the Simiadæ (or what used to be called Quadrumana) enough has been said, except that while the Cynomorpha are essentially quadrupedal, the manus even having an imitation of a heel by the elongation of the pisiform bone, the anthropoids approach more nearly to man than do any other animals in the characters of their hands and feet. The gibbons, arboreal animals, can nevertheless tread on the ground with the sole of their feet, and can stand upright easily, as well as run with great swiftness,



Claw of a Cat.

A retracted by the ligament *a*, and B protruded by the tendon *b* of the muscle flexor profundus perforans, overcoming the resistance of *a*.

helping themselves along with their great arms. The orang-outans cannot run in this way, but swing themselves along on the bent knuckles of the manus, as both manos and pes are by nature bent, and neither can be perfectly straightened. The chimpanzee can stand erect, and uses the sole of the foot, but prefers leaning on the knuckles of the hand, the body thrown forward. Finally, the gorilla, though adopting the attitude of the chimpanzee by preference (unless attacked, when he always rises to his full height), can stand erect more easily and firmly than any of the other anthropoids; but even in the gorilla, as in all the others, the natural position of the foot is with the sole bent inwards, so that unless by special effort the creature would walk on the edge of its foot. The foot is so articulated as to rotate with great ease—an arrangement as excellent for climbing as it is impeditory for walking.

FOOT, in English verse and in music, is a division of a metrical line or phrase into groups of accents. Among the ancients metre was given by long and short syllables, not by accents at all; and in this case the forms of two syllables were the trochee (represented by — ◡, where — is a long syllable and ◡ a short one), the spondee (— —), and the iambus (◡ —). The chief forms of three syllables were the dactyl (— ◡ ◡), the amphibrach (◡ — ◡), and the anapæst (◡ ◡ —). All these feet are imitated in English verse, but with strong and weak syllables instead of long and short ones. Coleridge's famous lines on metrical feet are so beautiful, and (substituting accent for quantity) give so accurate a conception of the principal kinds, that they naturally present themselves for quotation.

> Trŏchĕe trips frŏm long to short;
> From long to long in solemn sort
> Slōw Spŏndēē stālks; strong foot, yet ill able
> Ēvĕr tŏ cōme ŭp with Dactyl trisyllable.
>
> Ĭāmbics mārch from short to long;
> With ă leāp ănd ă boŭnd the swift Anapæsts throng;
> One syllable long with one short at each side
> Ămphĭbrăchys hāstes with a stately stride;
> First ănd lāst bĕing lōng, middle short, Amphimacer
> Strikes his thŭndĕring hōōfs like a high-mettled racer, &c.

FOOT, a standard measure of length. The hand and the foot, the span, the arm's length, and the elbow length (*ellenbogen*, *ell*) present themselves by nature as standards of measurement. The Greeks must have been a long-footed nation, for the ancient Greek foot (the *pous*), whence we get our own measure, is about $\frac{1}{10}$ of an inch longer than our own. The Romans shortened the foot by nearly half an inch, their foot (*pes*) being rather over $11\frac{5}{8}$ inches of our measure (11·6496). The Roman foot was divided into four "handbreadths" (*palmus*, very nearly 3 inches), and into 12 inches or "thumbnails" (*uncia* or *pollex*, nearly our inch, precisely ·9708 inch), as also into 16 "fingernails" (*digitus*, nearly $\frac{3}{4}$ inch, ·7281 inch); and $1\frac{1}{2}$ foot made the "cubit" (*cubitus*, 1 foot 5·475 English measure). The cubit contained two "spans" of about 9 inches each, the so-called *palmus major*. The measure of the Roman foot was arrived at by actual measurement of buildings, columns, &c., described closely in ancient writings, and by a large number of measurements of ancient Roman buildings on the assumption that they were likely to be of some precise number of feet rather than of an irregular measurement. Thus it would be likely that a palace wall would measure 100 feet rather than 99 feet 4 inches. A large extension of such observations served to justify the actual recorded measures shown above, and also explained a remarkable discrepancy between earlier and later feet; for the later buildings indicated the likelihood of a smaller foot being used, and this also bore out an otherwise inexplicable irregularity in the measurements of late writers. It would be a fair guess, seeing that our own feet measure less than 10 inches on the average for a full grown man, while the Roman foot-measure was nearly $11\frac{3}{4}$ inches, and the Greek $12\frac{1}{7}$ inches, to say that the foot of man has decreased in length from age to age. The only other explanation is that this extra inch is the "something given in" which makes our "hundred pounds weight" to be 112 lbs., and our hundred of fish, of oranges, &c., to be 120, and seems to satisfy a weakness of purchasing human-kind for getting somewhat beyond the bargain. It seems, however, more likely that the actual average foot was taken originally. This conjecture is further supported by the fact that the extremely ancient Babylonian foot measured not far short of $13\frac{3}{4}$ inches (1·144 English foot). The very old imperial Chinese foot is about $12\frac{6}{10}$ inches English; the mathematical foot of China (the *corid*) is $14\frac{1}{2}$ inches. The nearest measure of ancient Egypt does not bear the name of a foot, and is of the great length of 1 foot 5 inches.

The old French foot of Paris (*pied*) was discarded at the Revolution in favour of the metric system. It measured rather more than the English—namely, 1·066 foot, or nearly 1 foot and $\frac{8}{10}$ of an inch. The old German Rhenish foot (*fuss*) is also rapidly losing ground, but still holds its own. It measures a little over $12\frac{1}{3}$ inches English. The modern Roman foot is rather short, $11\frac{9}{10}$ inches. These are given as being frequently referred to; but it must not be supposed that they are, or were, supreme in their respective countries. It would fill a considerable space, on the contrary, to enumerate the various feet which existed in the memory of man, and many of which still are used in those countries which have not adopted the metric system. If we go further back it appears, on consulting any moderately complete list, as if every town of great importance had its own special foot. The Antwerp foot was larger than the Amsterdam foot, and both differed from the other Netherlandish feet; the Florence foot excelled the Roman, but both of these two had to yield the palm to the immense foot of Siena (nearly 15 inches long), and so also for other countries. See WEIGHTS AND MEASURES.

It seems quite certain that the foot is one of those measures destined to disappear in favour of the metric system, where the metre is the unit and is multiplied or divided by 10 as required. See DECIMAL SYSTEM.

FOOT AND MOUTH DISEASE (*Eczema epizootica, Aphtha epizootica*), among cattle, an affection of a highly contagious nature, consisting of a vesicular eruption on the tongue, mouth, teats, and between the digits of the feet, which if neglected runs on to suppuration and ulceration that, if occurring on the feet, causes sloughing of the hoof. It is, moreover, communicable from one animal to another of a different species, as experiments have proved. It has been communicated to the pig through the medium of food insalivated in the trough of a diseased ox. Calves and pigs have died after drinking milk drawn from affected cows. Hertwig, Villain, and Mann, for the sake of experiment, drank the warm milk from an aphthous cow, and produced upon themselves an eruption similar to that of epizootic aphtha. The disease must be communicated from one ox to another until it has involved so many in disease as to become epizootic. Animals, if placed in sheds in which aphthous cattle have been previously located, are nearly sure to become affected; and for this reason we find many animals conveying disease from the railway trucks in which infected ones have been placed; or it may occur from the intermixture of healthy with diseased stock in trucks during one and the same journey, and often afterwards contact at fairs or on farms leads to its still further propagation. This disease, which runs its course in nine or ten days, usually yields easily to treatment, which consists in washing the mouth twice daily with a weak solution of sulphuric acid and water, and the affected feet with carbolic acid and water. The lotion for diseased teats is composed of nitre and water. Sometimes the vesicles are broken down during the operation of milking, and sores are created, in which case it is good treatment to keep the sores clean, and to dress, after every milking, with glycerine. Mild aperients and diuretics should be given every other day during the progress of this malady.

FOOTBALL, a very general and favourite British outdoor winter game, is greatly practised at our public schools during the colder months of the year, especially at Eton, Harrow, Rugby, and Winchester, and at the principal universities. The game is very ancient. The Greeks played it, and so did the Romans—the latter, in Rugbeian fashion, using their hands as well as their feet. It is supposed to have come into Britain with Cæsar, but the first mention of it in our chronicles is in the latter part of the twelfth century, when William Fitzstephen, in his "History of London," writes of the young men of the city going on certain festivals into the fields to play football after dinner. In its early days the game was followed in a very primitive fashion, and in a desperately rough one, without any of the intricacy and manœuvring of modern play. One of the best features of football, ancient or modern, is that it may be played by any number, irrespective of age or size. The game has greatly extended its popularity of late years, for while it was formerly confined chiefly to the higher-class schools, it is now played in most of the villages and small towns of England. The rules for playing, while being the same in all places as to the chief points of the game, in respect to some important details vary between those known as the "Association" and the "Rugby." The Rugby form allows and the other disallows various kinds of handling the ball; such as seizing and carrying it, charging, &c. (Up till 1877 the detestable practice of hacking was allowed by Rugby laws.) The resulting "scrimmages" were found to produce severe injuries so frequently that a reaction in favour of playing more strictly with the feet set in. Attempts have been made to introduce a complete uniform code, but up to the present time without success. The following is the complete definition of terms of the game as they now stand:—A *place-kick* is a kick at the ball while it is on the ground, in any position in which the kicker may choose to place it. A *free-kick* is a kick at the ball in any way the kicker pleases when it is lying on the ground, none of the kicker's opponents being allowed within 6 yards of the ball; but in no case can a player be forced to stand behind his own goal-line. *Hacking* is kicking an adversary intentionally. *Tripping* is throwing an adversary by the use of the legs, or by stooping in front of him. *Knocking-on* is when a player strikes or propels the ball with his hands or arms. *Holding* includes the obstruction of a player by the hand or any part of the arm extended from the body. *Handling* is understood to be playing the ball with the hand or arm. *Touch* is that part of the field, on either side of the ground, which is beyond the line of play. The game is to make the greatest number of goals; and a Rugby goal is made by one party kicking the ball between the posts of their opponents' goal, and *over* a horizontal bar which connects the posts. The latter is 10 feet from the ground, and the former are 18½ feet apart. The Association goal is made by the ball being driven between posts 24 feet apart and *under* a connecting horizontal bar which is 8 feet from the ground. The shape of the ball varies in the two games—the Rugby ball being elliptical, the Association ball spherical. In each case the ball is large, and consists of an india-rubber bag inflated and then inclosed in a stout-laced leather cover.

FOOT-POUND is a term of invaluable service in the measurement of energy. It means the number of pounds raised 1 foot by a certain force, or the number of feet through which 1 pound is raised, and thus affords an easy common measure of energy or work done by that force. Thus a machine is said to do work equal to so many foot-pounds per second. Sometimes in measuring large expenditures of energy *foot-tons* are used. In either case the measure is obtained by multiplying the feet by the tons. Raising 10 lbs. or 10 tons 5 feet in a second would represent an energy of 50 foot-pounds or 50 foot-tons per second respectively; and a machine accomplishing this would be held to possess as much force as one which raised 50 lbs. or 50 tons 1 foot in the same time.

FOOT-ROT is a very painful and sometimes dangerous disease affecting sheep. It is of two kinds—the more common being that of the overgrowth of the hoof, which becomes turned down, cracked or torn, and thus affords a lodgment for sand and dirt. The second variety of foot-rot is more troublesome, and, unlike the other, is sometimes contagious. It commences in the parting of the hoof, and renders the foot hot, tender, and swollen. If it assumes a very serious shape poultices are advisable; but in milder cases the parts should be well washed with a solution of half an ounce each of sulphuric acid and oil of turpentine, mixed with a pint of water. When there are ulcers they should be touched with caustic or dressed with the ointment.

FOOTE, SAMUEL, was born at Truro, in Cornwall, in the year 1720. He was educated at Worcester College, Oxford, and on leaving the university he began the study of law, but soon grew tired of it. He married a lady of fortune; but the match proved an unhappy one, and he became a dissipated man. To redeem his fortune he tried the stage, at first in tragedy, but afterwards in comedy and farce. His wants, however, outran his power of satisfying them, and to relieve himself he aided Sir Francis Delaval to marry a rich lady, who was induced to accept the ruined baronet by the persuasion of a conjuror—a friend of Foote's. For this Foote received in return an annuity. It was not until Foote was a manager that he became well known as an admirable farce writer and a very able comedian. He opened the little theatre in the Haymarket, 1747, and subsequently obtained a patent through the accident of his breaking his leg while riding with the Duke of York. His death is said to have been hastened by his trial for a charge of the worst nature, although he was honourably acquitted. He was seized with paralysis while engaged on the stage, and died in

1777. The most popular of Foote's farces have been the "Mayor of Garratt" and the "Liar." Generally his plays were dramatic satires levelled at the manners and persons of his time, and therefore have little stage interest now.

FOR'AGE, hay, straw, and oats supplied to horses of officers and soldiers in the army. The provision of forage devolves on the commissariat when troops are together; but when a soldier is on duty away from his regiment, the innkeeper with whom he stops is bound, under the Army Regulation Act, to provide his horse with 10 lbs. oats, 12 lbs. hay, and 8 lbs. straw, for the payment of 1*s.* 9*d.* a day, which must also include stabling.

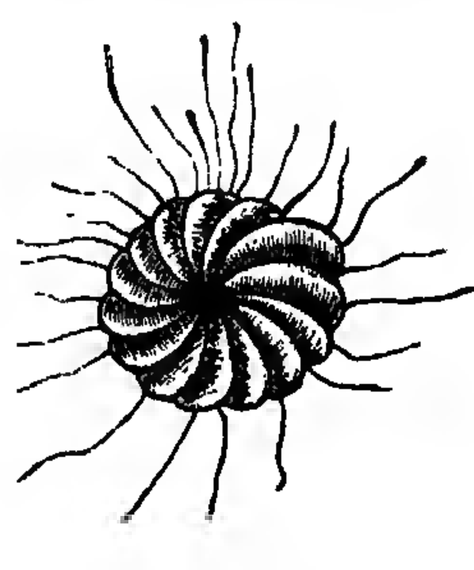
FORA'MEN, an opening or hole; a Latin word derived from *foro*, identical with our own verb to *bore*, the classic *f* being represented, according to its frequent custom, by the Teutonic *b*. It is specially used in anatomy to describe certain foramina or bore-like holes in the skeleton, the chief of which is the great occipital foramen beneath and at the back of the skull, through which passes the medulla oblongata, connecting the brain with the spinal cord. Other foramina in the skull often alluded to are the olfactory foramina and the optic foramina, through which the olfactory and optic nerves respectively leave the skull on their passage from the great ganglia at the base of the brain to the organs of sense. There are many other foramina in the skull for the passage of the other pairs of nerves.

The foramen ovale is the oval hole of communication between the auricles in the fœtus [see EMBRYO], which in the adult is closed up, a few traces of its presence being still visible in the wall of the right auricle. Other principal non-skeletal foramina are the foramen of Munro, connecting the third and the two lateral ventricles of the brain, and the foramen quadratum, or rectangular hole through which the great vena cava pierces the diaphragm. There are many other foramina of less importance.

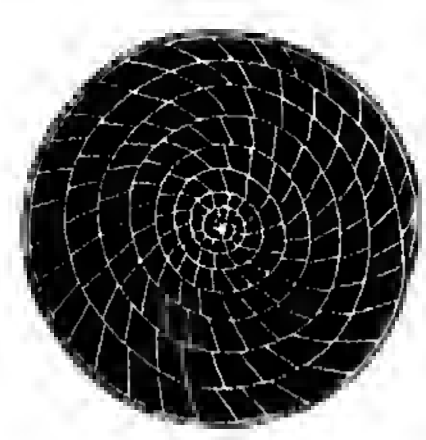
FORAMINIF'ERA, an order of PROTOZOA, referred to the class RHIZOPODA, and producing minute shells which tend to form many chambers. These shells often present a close resemblance to those of the Nautilus and other chambered cephalopods. Before the animals which inhabit these shells were discovered they were classed with the Mollusca, being called by D'Orbigny *Cephalopoda foraminifera*, as opposed to *Cephalopoda siphonifera*. The name, referring to the holes or foramina with which the walls separating the chambers of the shell are pierced, has still been kept for this group, though a knowledge of the animals has necessitated its removal to nearly the lowest grade of the animal kingdom. Dujardin in 1835 was the first to point out the lowly nature of these supposed molluscs. The animals are very simple in their organization, the body being composed of a homogeneous semi-fluid substance, *protoplasm*, which forms the "physical basis of life." The Foraminifera stand even lower in the animal kingdom than the AMŒBA, for the protoplasm of their body is not differentiated into an inner and outer layer (*endosarc* and *ectosarc*). A nucleus or many nuclei have been detected in some, and probably exist in all; this shows an advance on the MONERA, the lowest of all forms of animal life. As in Amœba, locomotion is effected by extending portions of the substance of the body, but in the Foraminifera every part of the protoplasm projects itself in these *pseudopodia*. The pseudopodia are usually long and delicate; they subdivide and branch extensively, coalescing wherever they come into contact, so as to form an irregular network, which has been compared to an animated spider's web. These pseudopodia have also a prehensile function, drawing into the central mass by their gradual contraction any large foreign bodies, such as infusorians, which have become entangled in the network. Minute particles of food are transmitted to the central mass by a constant circulation through the entire network—a phenomenon which may be compared to the circulation (*cyclosis*) of granules in vegetable cells.

Most of the Foraminifera are marine forms, and are

Cassidulina lævigata.



Polystomella crispa.



Horizontal section of *Nummulites lenticularis.*

Recent Foraminifera.

remarkable for the beauty and complexity of their shells. A few forms are found also in fresh water, and these have no shells. The simplest of these is Lieberkühnia, the body of which is naked; the branching pseudopodia issue from a stem put out from one part of the body. In Gromia the body is inclosed in a membranous case with an aperture at one end, through which issue the pseudopodia; these spread all over the test, covering it with a thin layer of protoplasm, from which layer fresh pseudopodia are given forth.

It has been usual to separate the shell-bearing Foraminifera into families, genera, and species, according to the structure and form of their shells, which often attain great complexity. A fuller knowledge of these forms has rendered this classification untenable. It has been shown that not only do endless modifications of the typical forms exist, but the whole of the Foraminifera can only be separated broadly into a few groups, within each of which every form passes gradationally into every other. Hence, though the old generic and specific names may be retained, they must not be regarded as having the same significance as in other groups. The shell-bearing Foraminifera may be divided into three suborders.

In the first suborder, *Arenacea*, the shells are made up of particles of sand cemented together by a sticky secretion of the protoplasm. According to Dr. W. B. Carpenter, the greatest living authority on the Foraminifera, lower forms exist consisting merely of aggregations of sand grains, "held together by a tenacious protoplasmic substance without any definite structural arrangement." In addition to grains of sand the shells are sometimes built up of spicules of sponges, or fragments of shelly matter, or minute foraminiferal shells. In some of this division, as Astrorhiza, there is no distinct orifice, the pseudopodia being pushed out between the loose sand particles. In higher forms, as

Lituola and the fossil Parkeria, there is present a distinct aperture, through which the pseudopodia are emitted; the sand particles are cemented together firmly, and the shell may attain considerable complexity.

In the next division, *Porcellana*, the shells are built up of carbonate of lime, extracted from the sea-water by the activity of the protoplasm. The name refers to their opaque-white porcellanous appearance when seen by reflected light. These shells have one distinct aperture for the emission of the pseudopodia. The simplest form is Cornuspira, with an undivided shell spirally coiled. In Miliola, by a process of budding, a succession of chambers may be formed, the last alone having an aperture. Fig. 1 of the Plate shows a section through one of these shells having eight chambers, of which three are externally visible (hence the name Triloculina). Fubularia (fig. 3), now extinct, and Dendritina (fig. 2), with its beautiful nautiloid shell, inhabiting tropical seas, belong to this suborder.

The last suborder, *Vitrea*, has a transparent glassy shell, with its walls perforated with numerous pores or canals for the emission of the pseudopodia. This suborder is often known as Perforata, the other divisions being Imperforata. The simplest form of shell is the single-chambered flask-shaped Lagena, with very small perforations in its shell. From this, by a process of budding, many-chambered shells are formed, either in rectilineal succession as in Glandulina (fig. 4) and Nodosaria, or alternately as in Uvigerina (fig. 5), or spirally as in Cristellaria. Another group, with GLOBIGERINA for its type, forming the family Globigerinidæ, has very coarse pores in the shells; figs. 6–10 belong to this family. The highest and most elaborate of the Vitrea fall within the family Nummulitidæ (figs. 11–13). [See NUMMULITES.] In this family there is an elaborate "canal system" subserving nutrition; a system of canals is formed between the chambers of the shells, communicating with the exterior. *Polystomella crispa* (see cut) is one of the most common British Foraminifera. Nummulites is very common in a fossil condition. Another of this family, *Eozoon canadense*, is the oldest known fossil, dating from the Laurentian period. Eozoon consists of a chambered calcareous shell, the protoplasm being replaced by a green silicated mineral. The organic nature of Eozoon is doubted by some, but the best authorities, including Dr. Carpenter, concur in regarding it as a true foraminifer.

Foraminifera are very abundant at the present day at the surface of all temperate and tropical seas. At a depth of from 1000 fathoms to 2400 fathoms the sea bottom is formed of a fine chalky ooze made up chiefly of the remains of Foraminifera, such as Globigerina. In greater depths than 2400 fathoms, as the *Challenger* expedition has shown, while Foraminifera still abound at the surface, their remains are not found on the sea bottom, which instead is covered with fine red clay, a silicate of iron and alumina. It is conjectured that this red clay is merely the insoluble residue of foraminiferal shells left after the calcareous portion has disappeared.

The recent species occur in various parts of the surface of the globe in immense numbers. The sand of the sea-shore in many places is so completely filled with them that it appears half composed of these elegant little shells. In the Adriatic Sea 4000 or 6000 have been found in an ounce of sand, and in the West Indies 3,840,000 have been found in the same quantity. If we calculate larger quantities, as for example a cubic yard, the amount surpasses all human conception, and we have difficulty in expressing the resulting number in figures. When we regard in this point of view the whole enormous mass of the sea-coasts of the earth, we must conclude that no other series of beings can, in regard to number, be compared with them. The part they play in creation at the present day is truly wonderful. Banks of sand which impede navigation, obstruct gulfs and straits, and fill up harbours, are their work; and along with corals they assist in forming those islands which are every day making their appearance in the warm regions of the great ocean. In former eras of the earth's surface the part they played seems still more striking. In the Carboniferous period enormous masses of limestone in Russia have been found composed almost entirely of a single species of Fusulina; and immense quantities occur in the Cretaceous formations in France. They were still more abundant in the Tertiary period. The stones of which the largest pyramids of Egypt are built are so full of a species of Nummulites, that these extraordinary erections appear to be almost entirely composed of them. The stone of which the houses and buildings of Paris are constructed is so full of a species of Miliola, that Paris and the villages in the neighbourhood may be said to be built of them. A cubic inch of the stone from the quarries of Gentilly contains upwards of 58,000 of these fossil shells, and the beds of which these quarries are composed are of great thickness and of vast extent. The actual number of such shells is thus inconceivable.

"The beds of chalk which underlie the nummulitic limestone, and occupy a still greater area, are essentially identical with the Globigerina ooze, the species of Globigerina found in it being indistinguishable from those now living. The remains of Foraminifera have been detected in the limestones of all epochs as far as the Silurian, and Ehrenberg discovered that an old Silurian greensand near St. Petersburg is composed of casts of Foraminifera just such as are now being formed in the Gulf of Mexico. And if the *Eozoon canadense* be, as it appears to be, nothing but an encrusting form of foraminifer, the existence of these organisms is carried back to an epoch far beyond that at which any other evidence of life has yet been found." (Huxley.)

FORBES, EDWARD, Regius Professor of Natural History in the University of Edinburgh, was born at Douglas, in the Isle of Man, in 1815. He commenced his career as a medical student at Edinburgh, but evincing a strong attachment for the study of zoology and botany he determined on devoting himself exclusively to a scientific career. He accordingly visited the coast of the Mediterranean and made the tour of Europe. Several interesting papers were the result of these journeys, as "Notes of a Natural History Tour in Norway," "Comparative Elevation of Testacea in the Alps," &c. One of the most important of his systematic works, prettily illustrated by his own pencil, was his "History of British Star-fishes and other Animals of the Class Echinodermata," which was published in 1841, and attracted considerable attention. In 1843, after a government appointment in Asia Minor, Mr. Forbes published an interesting "Report on the Mollusca and Radiata of the Ægean Sea, and on their Distribution as bearing on Geology." He was subsequently elected professor of botany at King's College, London, and also librarian and curator to the Geological Society, and was further appointed (in 1846) head of the Palæontological department of the Museum of Economic Geology. His excellent "History of British Mollusca" was published in 1853, in four vols. He was, besides, an extensive contributor to the reviews. In 1852 he was elected president of the Geological Society. He had previously been elected a fellow of the Linnæan and Royal Societies. In 1853 he obtained, what had long been the object of his ambition, the professorship of natural history in the University of Edinburgh, where he was enthusiastically welcomed by professors and students. But he lived only to complete one course of his lectures. He died in 1855.

FORBES MACKENZIE ACT. This statute, entitled an Act for the better Regulation of Public Houses in Scotland, is popularly known by the name of the gentleman who introduced it into the House of Commons. It

enacts that inn or hotel keepers "shall not keep open house, or permit or suffer any drinking in any part of the premises belonging thereto, or sell or give out therefrom any liquors before eight o'clock in the morning, or after eleven o'clock at night of any day, with the exception of refreshments to travellers or persons requiring to lodge in the said house or premises; and further, that they shall not open their houses for the sale of any liquors, or sell or give out the same on Sunday, except for the accommodation of lodgers and *bonâ-fide* travellers." The same restrictions are imposed upon public-house keepers and all dealers in intoxicating drinks, with this addition, that no exception is made in their case in favour of travellers or lodgers. In 1859, a Royal Commission inquired into the working of the Act. They concluded "that although intemperance still prevailed to a lamentable extent, it would seem that this vice has been for some time gradually descending in the scale of society, and that it is now chiefly confined to the lowest class of the population. The beneficial effect of the Act is proved by the evidence which we received as to the diminution of crime, and the change for the better in the habits of the people."

FORCE, a term which is employed to denote the unknown cause of any mechanical effect. It is that which tends to produce motion in a body at rest, or to produce change of motion in a moving body. Thus the cause of motion and the cause of pressure are both forces. Again, difference of effects must be attributed to difference in the producing causes; thus greater or less velocity and greater or less pressure are both attributed to differences in the causes of velocity or pressure. But, on the other hand, effects which are the same in one point of view may differ in another; thus bodies of different weights let fall from the same heights above the ground will strike the ground with the same velocities, but with different degrees of effect upon the substance which they strike. Again, if a ball be thrown upwards with a velocity a, which carries it to a height b, it will, when thrown upwards with twice the velocity, ascend through four times the height b.

In the theory of equilibrium force is a synonym of pressure, and weight is its measure. In this definition time is not one of the elements; but it is easily seen that wherever pressure is produced motion is prevented; if, for example, a string by which a weight is suspended be suddenly cut the weight will descend. It is also proved that if a certain rate of motion be communicated to matter, the matter will preserve that motion unaltered till some external cause interferes. On this axiom the notion of force, as causing motion, depends for precision; the alteration of velocity is the evidence of the existence of force.

When force, in the sense of pressure, is considered as the cause of motion, we must take into account both the element time, and also the quantity of matter which is moved. The connection of pressure, velocity created by pressure, and time which pressure takes to create velocity, as deduced from experiment, are contained in the following results:—

1. The same pressure continually acting upon a given mass for different times produces velocities which are proportional to the times, and augments velocity by equal portions in equal times.

2. The same pressure applied to different masses of matter (that is, to different weights of matter) during the same time, produces velocities which are inversely proportional to those masses.

3. The velocity of falling bodies is accelerated by 32·19 feet in every second, and in that proportion for all other times.

In different masses the pressures necessary to destroy motion in a given time are as the products of the masses and velocities. Thus the pressure which will in one-hundredth of a second reduce to rest a mass of 10 oz. moving 100 feet per second, is to the pressure which will (also in one-hundredth of a second) reduce to rest 20 oz. moving 85 feet per second, as 10×100 is to 20×85, or as 1000 is to 1700. It is customary to call this product of mass and velocity the momentum or *moving force* of the body.

When bodies are in motion, with a continually varying velocity, it becomes desirable to consider their motion, not with reference to the masses which are moved, but solely to the alterations of velocity produced; and it is customary to ascertain the amount of velocity which would be produced in one second if the acceleration at the point in question continued uniformly. [See ACCELERATED MOTION.] This force is called the *accelerating force*, and it is found by the rules of the differential calculus in the following manner [see VELOCITY]:—If a point move in a line in such a manner that x feet is its distance from a given point in the line at the end of the time t seconds, and if x be a function of t, then the velocity of the body, v, at the end of the time t is $\frac{dx}{dt}$ feet per second, and the acceleration which that velocity is then undergoing is such as, if allowed to continue uniformly for one second, would increase the velocity by $\frac{dv}{dt}$ or $\frac{d^2x}{dt^2}$ feet.

If f represents this accelerating force, we have then

$$v = \frac{dx}{dt}\,;\ f = \frac{dv}{dt} = \frac{d^2x}{dt^2}\qquad v\,dv = f\,dx.$$

These are called the *equations of motion*.

From what precedes it may be shown that accelerating forces are proportional directly to the pressures which produce them, and inversely to the masses in which they are produced. Forces are usually represented by lines, the direction of the force being indicated by an arrow or by the order of letters; as,

the force A, $\overset{\text{A}}{\longrightarrow}$, or the force A B, $\overset{\text{A}\qquad\quad\text{B}}{\overline{\qquad\qquad}}$;

and the relative magnitude of the force by the length of the line.

FORCED LOANS were first resorted to (in any great extent) by Richard II. to replenish his empty exchequer on the failure of arbitrary taxation, and his extortions under this head were one main cause of his deposition. This method of evading the stringent provisions against unparliamentary taxation contained in Magna Carta was invented by the son of the king from whom that charter was extorted. It was Henry III., son of John, who first hit upon the idea of "forced loans." Edward II. also used this means of obtaining money.

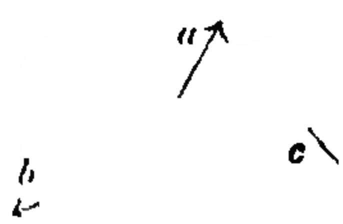
After Richard's deposition, the Lancastrian kings, whose title was defective and who depended greatly on parliamentary support, quite abandoned this illegal system of pseudo-taxation; but their successors, the Yorkists, were not so scrupulous. The barons had killed or impoverished one another in the French wars and the Wars of the Roses, and Edward IV. found many ready to make their peace in their weakened state by money gifts. The euphemism of "benevolences" now took the place of the truer phrase "forced loans," if indeed that can be truly called a loan which was never or practically never repaid.* See BENEVOLENCE.

FORCES, IMPRESSED AND EFFECTIVE. When various pressures act at different points of a system, the forces which act upon any one point are not those which would by themselves produce the motion which that point really has in consequence of the motion of the system. Thus, suppose a pendulum with two balls, one above and the other (which suppose much heavier) below the point of suspension. The forces which act on the upper ball would, if it were free of the larger one, cause it to descend; while, in consequence of the connection of the

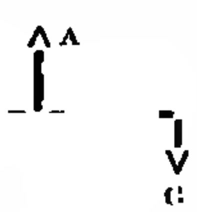
two balls, the smaller actually does vibrate like a pendulum turned upside down, or as if its gravitating tendency were upwards instead of downwards. Here is an instance in which the impressed force acts downwards and the *effective* force upwards: that is, the motion which actually ensues is such as would require a force acting upwards to cause it.

One of the most important principles in dynamics is that known by the name of D'Alembert, and is enunciated thus: the impressed forces are altogether equivalent to the effective forces, or, if the directions of the latter were all changed, the former would equilibrate them. See VIRTUAL VELOCITIES.

FORCES, PARALLELOGRAM OF. Any two forces acting at the same point, and represented in magnitude and direction by two straight lines, are equivalent to a third force which is represented in magnitude and direction by the diagonal of a parallelogram constructed with the two lines as adjacent sides. [See COMPOSITION OF FORCES.] This theorem is frequently called that of the *parallelogram of forces.* Another problem of forces, closely connected with the above, is called the *triangle of forces.* If three forces acting in different lines are in quilibrium, their lines of action are in one plane and either meet in a point or are parallel. Let a b c be three forces, whereof c balances a and b, acting at one common point. Then if we draw a line a, whose length and direction represent the force a, and another line b from its extremity, representing in like manner the force b, a third line joining these two lines will make a triangle, and the side c thus obtained will represent the third or balancing force in magnitude and direction. Thus, if we know the data of any two forces, we can find those of a third which will balance them. The forces in the triangle will be found to be all pointing in one direction of rotation.



If the forces are parallel and in equilibrium the two outside forces must be in the same direction with each other, and in an opposite direction to that of the central force; and the latter must exactly equal the sum of the other two. Thus, in order to produce equilibrium, B and C must equal A in magnitude and oppose it in direction.



FORCING, in horticulture, is the art of hastening the growth and maturity of flowers, fruits, and vegetables by artificial means. Many of our finest exotic fruits are indigenous to warmer countries, and would scarcely ripen even in our warmest seasons; but by this art they are brought to great perfection in cold climates, and by advancing or retarding artificially the growing season of hardy kinds, they also can be had in regular succession throughout the greater part of the year.

The fruits of warmer climates, growing in a wild state, enjoy a greater degree of light than it is possible to give them in this country at any season of the year, and this is one of the most important circumstances to attend to in the art of forcing. Nature is in all respects the best guide in these matters, and care should be taken to imitate her as far as possible; first, by taking care that forced plants are exposed to all the light that can be collected; and secondly, by preserving a due proportion between the quantity of heat and light to which forced plants are exposed; in other words, by not forcing too hard at a season when the sun's rays are least powerful, thus acting in direct opposition to the laws of nature. Attention to this is the corner-stone of the whole process. When early crops are more desirable than high-flavoured fruit, gardeners are obliged to apply heat without reference to the intensity of light; but if this is not the object, forcing should never be commenced before the spring, in order that the fruit may have the greatest degree of light when ripening. These principles are now generally understood and appreciated, and consequently our peaches, grapes, and other forced fruits are even superior to those grown under the clear skies of the south of Europe.

It appears to be a general rule that plants from warm countries endure with impunity a very high degree of temperature, while those of more temperate regions are impatient of artificial heat, and hence the difficulty of forcing the plants of northern climates; for example, the same degree of heat in which vines flourish would be much too high for cherries, which throw off their blossoms after expansion without setting their fruit. Extreme caution is therefore necessary in forcing the fruits of northern climates. First, the increase of temperature must be slow and gradual, and never at its highest point exceed 60° or 65° Fahr. with artificial heat; air must be freely introduced, particularly in fine bright weather, and the house so constructed as to admit of the greatest possible quantity of light, as, for instance, having movable lights which can be taken off and put on at pleasure.

The Dutch have long been celebrated as excellent forcing gardeners, and as their manner of performing the operation is peculiar, a description of it may be interesting. The principal feature in their system is conducting the operation chiefly in frames and pits heated with fermenting dung. The trees employed in forcing are generally taken from a wall in the open air, planted in a rich border of leaf mould, and trained to a trellis a few inches below the glass; here they remain until they have ripened their fruit, after which they are moved back to the wall until wanted for the same purpose in some succeeding year: they never force from the same plant two years in succession. Their system of employing dung instead of fire heat gives them an excellent opportunity of forcing vegetables, such as French beans, endive, lettuce, &c., which are either placed on, or plunged in, the bed in the inside of the frame.

FORD, the name applied to that part of a river where the water is sufficiently shallow to admit of wading through it, and thus crossing over without having recourse to a bridge, a ferry, or other similar means of passage.

Rivers whose banks are steep and course straight are rarely fordable, for in such the water is generally too deep or too rapid to admit of fording. Small and regular streams issuing from springs in flat countries are generally fordable at all times and in all parts. The most common cases, however, are those of temporary and changeable fords. Permanent fords, and such as are occasionally impassable, were used long before bridges were constructed; and as travellers from a distance sometimes on arriving were unable to cross the river, hostelries for their temporary reception were constructed on the banks. Such has been the beginning of many towns whose names still commemorate their origin, as Chelmsford, Bedford, Oxford, Stratford, &c.

Such rivers as flow through a loose soil, as sand or gravel, have generally a very winding course, and are almost constantly shifting their channel. Banks are at times carried away by floods, and others formed in parts that before were deep, so that often the place of the ford is changed.

In military operations fords are of the greatest importance. They are generally found either in the widest part of the river or in the direction of the diagonal line that joins the salient angle of one side to the salient angle of the other side. In the first case the waters spread out in the wider part of the bed of the river, and are therefore less deep; and in the second there is always a deposit in front of the salient angle, and consequently the water is more shallow in those parts. Fords for infantry should not exceed a depth of 3 feet, and for cavalry that of 4 feet. These are the extreme depths, and if the current be somewhat rapid it is dangerous to risk fording through more than 2 feet of water for infantry and 3 for cavalry.

FORD, JOHN, one of the later Elizabethan dramatists, was of a good Devonshire family. He was the second son of Thomas Ford of Ilsington, and was born in 1586. He entered as student of the Middle Temple in 1602, and became a successful lawyer, a fairly wealthy man, living a sober retired life, in great contrast to some of his brother dramatists. He took to writing plays as a recreation, giving his entire leisure to the work and aiming at fame rather than reward. Ford is an excessively powerful writer, but his dramas cannot be called pleasant reading. His love of the horrible and repulsive as themes for his indignant exposure is pushed to morbid excess; for after all a constant presentation of crime and vice, though it be earnestly denounced the while, is not conducive to the amelioration of taste. Ford paints us it were in violent contrasts of black darkness and lightning flashes. A squib of the time is worth quoting to show the opinion of his contemporaries.

"Deep in a dump John Ford alone was got,
With folded arms and melancholy hat."

Though Ford was born under Elizabeth, and continued the Elizabethan style, he wrote principally under Charles I. He certainly stood among the chief dramatists of his own day. He died in 1639. Though "The Broken Heart" and "Love's Sacrifice" are generally esteemed his masterpieces, the tragi-comedy of "The Lady's Trial" is probably now most enjoyed.

FORD, THOMAS, a composer of music of great merit, was one of the glories of the Elizabethan school. He was one of the musicians of Prince Henry, the eldest son of James I., whose death in 1612 placed his younger brother Charles as heir to the throne. The date of Ford's birth is variously stated, but he died in 1648. There are probably few English melodies better known than his exquisite part song, "Since first I saw thy face," which is one of the greatest favourites with our choral societies to this day. The work containing this and other gems has also much instrumental music for lutes and viols, chiefly various dances, as pavens, galiards, thumpes, and such like.

FORE, in nautical language, that part of a ship which goes in advance of the stern. *Fore and aft* signifies the whole length of the ship. The *foremast* is the most forward mast. The *forecastle* is that part of the upper deck of a ship forward of the foremast; or, in a merchant vessel, the forward part, under the deck, where the sailors' quarters are appointed.

FORECLOSURE OF MORTGAGE. A mortgagee, or any person claiming an interest in the mortgage under him, can compel the mortgagor, after breach of the condition in the deed (that is, non-payment of principal and interest at the time stated), to redeem, *i.e.* pay off, the mortgage by a certain day, or in default be foreclosed or debarred from his equity of redemption. This is now done by an action of foreclosure.

The courts usually show considerable indulgence to a mortgagor who has any prospect of paying, and an infant mortgagor is given a day to show cause within six months after attaining his majority. See also MORTGAGE.

FOREIGN ENLISTMENT ACT. The first legislation on this subject was the 29 Geo. II. c. 17, which was passed to prevent his Majesty's subjects from serving as officers under the French king, and for obliging such as should accept commissions in the Scotch Brigade in the service of the States-general of the United Provinces to take oaths of allegiance and abjuration. Two Acts were also passed in the same reign referring to the king's Irish subjects, and the 9 Geo. III. c. 30 was an Act to prevent the enlisting of his Majesty's subjects to serve without his license. By the 59 Geo. III. c. 69, known as the British Foreign Enlistment Act, all the above Acts were repealed, and fresh enactments were made which continued to be the law on the subject for many years.

The case of the vessels fitted out from England for the Confederate States of America during the Civil War, caused great discussion, and thoroughly ventilated the principle of the Foreign Enlistment Act; and immediately war was declared between France and Germany in 1870, an Act was passed which went far beyond any law previously in force in any country, for the purpose of enforcing neutrality, and involved a total revolution in the ideas of English statesmen with regard to the duties of neutrals. The chief provisions of the Act are, that a penalty of fine and imprisonment, or both, at the discretion of the court, may be imposed for enlistment in the military or naval service of any foreign state at war with any state at peace with her Majesty, or inducing any other person to accept such service. Similar penalties are imposed for leaving her Majesty's dominions with intent to serve a foreign state, or for embarking persons under false representations as to service. Any master or owner of a ship who knowingly receives on board his ship, within her Majesty's dominions, any person illegally enlisted under any of the circumstances above described, is made liable to fine and imprisonment; his ship may be detained till all the penalties have been paid, or security given for them; and the illegally enlisted persons are to be taken on shore, and not allowed to return to the ship.

But the most interesting and important division of the Act is that which relates to illegal shipbuilding and illegal expeditions, and which it is hoped will save this country from the necessity of again paying such a sum for damages as was handed to America in 1873 under the *Alabama* arbitration award, made in the previous year. As in the previous Act, it is declared to be an offence to commission, equip, or despatch any ship with intent or knowledge, or having reasonable cause to believe, that the same will be employed in the military or naval service of any foreign state at war with any friendly state. The offender is punishable by fine and imprisonment; and the ship, with the equipment, is to be held forfeited to her Majesty. But over and above this, the new Act embodied a provision, making the building of a vessel under such circumstances an offence in itself; and what is more, the onus of disproof lies with the builder. Further, it is declared an offence to augment the warlike force of any ship for the use of a belligerent. These clauses are intended to check the practice adopted during the American War, of building or fitting out a vessel in this country and then sending her either out to sea or to some other neutral port to take on board an armament sent to meet her in some other ship. The defects of the law were strikingly illustrated in the American Civil War by the two cases of the *Alabama* and the two ironclad rams *Scorpion* and *Wyvern*. While the former escaped because the authorities had no instructions to seize her, even though her intended use and destination were perfectly notorious; in the other instance, the government took the law into their own hands, and arbitrarily seized the rams on their own responsibility. The law is now sufficient to meet all cases of this description, and to spare the authorities any necessity of straining it in order to discharge the obligations of a neutral. This branch of the measure is completed by two other clauses, enacting that illegal ships shall not be received in British ports; and making it an offence, punishable with fine and imprisonment, to prepare or fit out, or in any way assist in preparing, any expedition to proceed against a friendly state, all ships forming part of such an expedition being forfeited to the crown.

A special power is given to the secretary of state, or chief executive authority, to issue a warrant to detain a ship if "satisfied that there is a reasonable and probable cause for believing" that it is being built, equipped, or despatched for an illegal purpose. The "local authority" may also detain a suspected ship until reference can be

made to the secretary of state or chief executive authority. The secretary of state may issue a search warrant in any dockyard in the queen's dominions. The decision of the important question whether a ship is or is not rightly suspected is withdrawn from the cognizance of a jury and submitted to the consideration of a judge.

The export of arms from a neutral country to belligerents has been a question more difficult of settlement; and the clause on this subject in the treaty of Washington formed matter of controversy between the British and United States governments from 1871 to 1875. See INTERNATIONAL LAW.

FORELAND, NORTH and **SOUTH,** two headlands of England, in the county of Kent, about 14 miles apart. They form lofty chalk cliffs, and are provided with lighthouses, one on the North Foreland 184 feet, and two on the South Foreland, respectively 372 and 275 feet above the sea. Bloody Foreland, or Farland, the extreme north-west promontory of the county of Donegal, Ireland, is 38 miles long, north to south, and 36 miles broad.

FORESHORT'ENING is a term applied to the method or art of presenting objects, by means of drawing, that are approaching the eye in an almost direct line, as they really are. The lines of perspective, under these circumstances, will appear much *shortened*, and the spectator will see little more than the *fore* end, or that part which is nearest to him.

FOREST, an extensive tract of ground overgrown with trees and underwood. Trees, like all other vegetables, require, according to their several natures, and independent of suitable soils, different modifications of heat, light, and moisture; circumstances which, so far from being influenced by latitude alone, are much more dependent upon the height above the level of the sea, its vicinity, and other circumstances, than upon proximity to or distance from the equator. Humboldt states that, whether we ascend from the plain of Orotava to the top of the Peak of Teneriffe, or from the shores of the Pacific to the summit of the Mexican Andes, we find different zones of vegetation, in which the succession of forest-trees follows generally the same order that is observed in passing over the surface of the earth from the equator towards the poles.

The British Isles, like other countries of Europe, were in former times much more abundantly covered with timber than they are at present. The increase of population tends to the destruction of forests by causing a demand for the productions of arable land. But though we have now hardly any forests of considerable extent, there are, perhaps, few countries over which timber is more equably distributed. Woods of small extent, coppices, clumps, and clusters of trees are very generally distributed over the face of the country, which, together with the timber scattered in the hedgerows, constitute a mass of wood of no inconsiderable importance. Scotland contains forests in Aberdeenshire and Inverness-shire. Ireland is almost without forests.

In Norway the mountains are covered with wood—birch, maple, pine, and fir forming immense forests. The fir, sometimes attaining a height of 160 feet, is in great estimation for masts and building timber. In the regions of moderate elevation are aspens. The good lands have some fine forests of oaks. The forests of Sweden are similar to those of Norway. In Denmark the existing forests cover but a small area, but great efforts are being made to increase their extent. The timber of Holland consists of beech, fir, poplar, and ash; willow grows along the canals, and the coppices are of maple, ash, hornbeam, birch, and beech, with a slight portion of oak-bushes. In Germany and Austria the forests are estimated to cover about one-third of the whole surface, though some consider this estimate too large; they comprise most of the usual varieties of timber trees.

Switzerland is abundantly wooded, particularly with the cone-bearing trees. Oaks are found occupying a region which rises to the height of 2800 feet above the sea, beyond which, and to the height of 4000 feet, there are beech woods; the firs are found at the height of 5500 feet. France has many fine forests, though hardly sufficient for the consumption of a country where wood is the chief combustible, and where the state of the arts and general civilization create a constant demand for large timber and wood of every kind. The variety of climate and position in that country is, however, favourable to the growth of all kinds of European and many exotic trees. The woods are pretty generally distributed over the country. Italy, Spain, and Portugal are all rather deficient in forests. European Turkey has fine forests of oak, elm, pine, plum, apple, pear, cherry, apricot, maple, sycamore, walnut, chestnut, and beech trees.

Of all the countries of Europe Russia is the most abundantly provided with timber; and her forests would be an almost inexhaustible source of wealth if it were possible for the government effectually to protect them from destruction. In 1802 regulations for the preservation of the forests were established; but such is their extent and that of the country, that it is next to impossible wholly to prevent the waste of wood. There are 200,000,000 of acres exclusively covered with pine and other cone-bearing trees, without counting oaks, maples, beech, poplar, hornbeam, and birch. Poland is, for its size, nearly as well supplied with forests as Russia.

In Asia Minor, Mount Taurus is covered with forests of cypress, juniper, and savines. Oaks and fir abound in the forests along the Black Sea. Trees of all these kinds occur in the Caucasus. Persia has few forests except among the mountains near the Caspian. Arabia has none. Central Asia is too little known to yield us much information respecting its forests. Siberia has some vast forests of the harder kinds of trees. China, Japan, and Corea all possess immense forests in their mountainous districts. India, both within and beyond the Ganges, is rich in wood. There are whole forests of the bamboo, which sometimes attain a height of 60 feet. Cocoa-nut and palms of all kinds cover large tracts. Here are woods of oak, fir, cypress, and poplar; there of mangoes, banyan trees, uvarias, robinias, sandal-wood, the lately introduced cinchona, &c. Nearly all the Eastern islands are rich in forests, Australia excepted.

All recent travellers in Africa characterize the vegetation and forests of that continent as rich beyond all description. Senegambia, Guinea, and Congo are covered with forests, which consist of the baobab, of palms, robinias, sycamores, sandal-wood, tamarinds, bananas, oranges, limes, and pomegranates. The tamarind and cedar, which grow in the greatest profusion on the borders of the Congo, furnish timber of the finest quality. Abyssinia has abundant woods. The Atlas mountains are covered with magnificent forests, producing a variety of oaks, the mastic tree, the cypress, &c. The island of Borneo also has immense forests.

America is, of all parts of the world, the most thickly covered with wood. The territory on the north-west coast, purchased from Russia by the United States in 1867, is abundantly stocked with fine timber; pines 300 feet high and 45 feet in circumference, Canadian poplar, alders 40 feet high below the branches, birch, yew, black and common oak, American ash, sycamore, sugar maple, cypresses 24 feet in circumference, and willows. Canada contains immense forests, but reckless commercial destruction has caused a serious decrease. Most of the British North American territories are well wooded. The United States are fairly wooded, though it is doubtful if any more destruction of timber would be safe; that portion, however, still covered with the primitive forests contains an

immense variety of trees. There are about forty different kinds of oak, fourteen of pine, cedar, cypress, larch, several maples, birch, ash, beech, iron-wood, hornbeam, hickory, wild-cherry, and apple; mulberry, poplar, willow, magnolias, elm, chestnuts, &c. Oregon, Mexico, and Texas have all splendid forests. The West India Islands are for the most part only moderately wooded. In South America the Caracas possesses inexhaustible forests, and so indeed do most of the South American states. The forest region of the river Amazon and of the upper Orinoco, according to Humboldt, covers an area of about 719,000 square miles.

From the above rapid sketch of the forest lands of the globe it appears that they still cover a great portion of its surface, and their influence is both direct and indirect. The direct influence is the diminution of temperature, effected, according to Humboldt, "(1) by screening the soil from the heat of the sun's direct rays; (2) by the powerful evaporation of moisture from the leaves; and (3) by the immense surface which these same leaves offer to the cooling process of radiation." The indirect influence is the preservation of that due circulation of moisture by which the fertilizing rivers of the earth's surface are furnished with a perennial supply of water. Such, indeed, is the importance of forests in this respect, that if it were possible to annihilate at once all the forests that now exist, the earth would be no longer habitable. The rain which falls in the mountains, no longer arrested by the trunks and roots of the trees, would not have time to percolate through the soil and fissures of the rocks to supply the reservoirs of springs, but would flow down in devastating torrents, leaving the water-courses dry as soon as the rain had ceased. This has been experienced in many places where the heights have been denuded of their forests. Especially has it been the case in some parts of Spain, where millions of acres of once fertile land have been converted into dry and barren wastes. The Po now transports three times as much sediment as formerly, the increase being chiefly due to the destruction of the forests, and the consequent increased denudation of the Alps. French engineers estimate that the delta of the Rhone has advanced at a rate far greater than it did previous to the cultivation of its valley. In the Eastern United States, wherever a mountain slope has been stripped incipient ravines quickly form, and enlarge with such rapidity as to excite the attention of geologists. This is especially the case with the sandy soils of Maryland, Georgia, and Alabama, previously covered with pine forests. The black earth of Russia, one of the chief sources of the agricultural wealth of the empire, is quickly cut up into huge ravines, and the finest soil in Europe is being rapidly carried away to increase the deltas of the Volga and the Don, and to silt up the Sea of Azov. During the great floods of 1866 and 1868 in France and Switzerland the wooded soils alone escaped being washed away. The immunity of the provinces of Brescia and Bergamo from damage by the great floods of 1872 was chiefly due to forestal improvements. During ten years the department of the Lower Alps lost 61,000 acres of cultivated soil from the effects of torrents; and the clearing of the forests of the Ardèche has resulted in the covering up of 70,000 acres of good land with barren sand and gravel. If forests were generally destroyed, even worse results than those would occur; lakes, for want of supply, would be dried up; and as no waters but those of the ocean would then exist, the atmosphere would be deficient in moisture, no vegetation could exist, and the animal world would perish with thirst, hunger, and heat. Forests are thus of primary importance in the economy of the globe, independent of their utility in a thousand arts which are necessary now to our comfort.

FOREST FLY (*Hippobosca equina*) is an insect belonging to the order DIPTERA. In the forest fly, as in others of the same suborder (PUPIPARA), the eggs are hatched in the body of the parent, and the larva is nourished and undergoes its change into the pupa state in the same situation; in this state it is deposited by the parent. The forest fly is abundant in Hampshire. It is well known for its attacks on horses. The only way of removing the pest is by picking it off, so firmly does it fix itself, clinging by its hook-like claws with the utmost tenacity. The organs of the mouth are well adapted for piercing the skin and sucking the blood of its victims; they are considerably modified from the typical structure of the Diptera. When these insects are placed on the ground after being caught, they run with considerable speed sideways, like a crab, to which in reality they bear a considerable degree of resemblance. They are small insects with long wings; the general colour is brown. They have a remarkably tough skin, which renders it a matter of difficulty to kill them. The forest fly attacks other quadrupeds—asses, sheep, and oxen.

FOREST LAWS. The earliest appearance of forest law in England is an edict of Canute to this effect—"I will that every man be entitled to his hunting in wood and field in his own possession; and let every one forego my hunting, take notice where I will have it untrespassed upon, under penalty of the full *wite* (fine)." After the Norman conquest the royal forests were guarded with much strictness; their number was extended, and possibly in some cases their bounds enlarged; and finally, there was established a new system of laws and of courts for their administration, by and according to which not only all offences touching the royal forests were tried, but also all persons living upon these properties were generally governed. This is the system or code that is properly called the forest laws. The Conqueror is said to have possessed in different parts of England 68 forests, 13 chases, and 781 parks. He assumed that hunting deer was a royal privilege—he "loved the tall deer as if he were their father," as the English Chronicle says bitterly—and took the forest almost as his private property. Trespassers were severely punished—often with loss of sight; large tracts of land were afforested and their inhabitants driven away. William Rufus even exceeded his father in strictness, and Henry I., in his charter of liberties (1100), specially refuses to yield his forest rights (Stubbs' "Select Charters," 101); he even made some new forests, which, however, his successor Stephen found it wise to restore. It was Henry I. who established the forest courts, held for a long time with great regularity. The system, when perfected by the excellent business arrangements of the practical Henry II., ran as follows, the last "court of justice seat" being held by the Earl of Holland in Charles I.'s time, and other courts continuing irregularly till the Revolution of 1688:—

The *Woodmote*, or *Court of Attachments*, held every forty days to inquire into offences against *vert* and *venison* (*i.e.*, against trees and game).

The *Court of Regard*, held every three years for the mutilation of dogs by cutting a claw, or the ball of the forefeet, to prevent their hunting.

The general *Court of Sweinmote*, held thrice a year.

And finally, the *Court of Justice Seat*, held before the Chief-justice in Eyre, for the formal trial of all cases connected with the forests.

Henry II. held personal visitations of the forests in 1167 and 1175, and in 1184 issued the great Assize of the Forest at Woodstock, a very severe code—enforcing also attendance at the forest courts above mentioned. The fines for non-attendance grew to be so excessive that in articles 44, 47, and 48 of Magna Carta dwellers outside the forest were specially excused. The charter also provided for an examination into forest laws, "all bad customs" connected with which were "to be abolished." The great Charter of the Forest of Henry III., 1217, also

promised amendment, and did actually abolish the punishments of mutilation and of death for forest offences. But this charter was so often infringed that Edward I. was called upon to specially promise reform in 1300, and with his usual promptness this was done in 1301. At the accession of Edward III. the forest laws were again solemnly revised and their severity reduced, and the forest courts were brought under the control of the King's Bench.

For the antiquity of the royal forests in England "the best and surest argument," says Coke (4 Inst. 319), "is that the forests in England, being sixty-nine in number, except the New Forest in Hampshire, erected by William the Conqueror, and Hampton Court Forest, by Henry VIII., and by authority of Parliament, are so ancient as no record or history doth make any mention of their history or beginning."

The four principal forests in England were accounted to be the New Forest, Sherwood, Dean, and Windsor. Among the others were Epping, in Essex; Dartmoor, in Devonshire; Wickwood, in Oxfordshire; Salcey, Whittlebury, and Rockingham, in Northamptonshire; Waltham, in Lincolnshire; Richmond, in Yorkshire, &c.

The oppressive powers vested in the crown by the forest laws, after having to a great extent long ceased to be exercised, were revived by Charles I., who extended the boundaries of the forests, and by levying heavy fines endeavoured to turn them to account in replenishing his empty exchequer. This was one of the grievances to which the Long Parliament directed its earliest attention; and since the passing of the 16 Char. I. c. 16, the old forest laws may be considered as practically abolished, and the offices connected with their administration and execution are now sinecures.

FOREST MARBLE is the name given to a series of beds forming the uppermost member of the Great Oolite, a division of the Lower Oolite. These beds are for the most part shelly limestones, passing occasionally into marble, but a well-marked clay bed (the Bradford clay) occurs among them. The series attains a thickness of 450 feet in Dorsetshire, but thins away towards the north and east. Among its fossils oysters are very abundant, Pectens (scallops), Aviculæ, Terebratulæ, Pentacriuites, and several urchins occur; *Apiocrinus rotundus* (a sea-lily) is especially characteristic of the Bradford clay.

FORESTALLING, ENGROSSING, &c. *Engrossing* was the offence of purchasing large quantities of any commodity in order to sell it again at a higher price. There were numerous statutes against this offence, and it was also an offence at common law. The English were not singular in this absurd species of legislation.

Forestalling, also an offence at common law, is described in a statute of Edward VI. to be the buying or contracting for any merchandise or victual coming the way to market; or dissuading persons from bringing their goods or provisions there, or persuading them to enhance the price when there.

"*Regrating*," says Blackstone, "was described in the same statute to be buying of corn or other dead victual in any market and selling it again in the same market, or within four miles of the place. For this also enhances the price of provisions, as every successive seller must have a successive profit." As to engrossing, Blackstone remarks, "This must of course be injurious to the public, by putting it in the power of one or two rich men to raise the price of provisions at their own discretion."

Notwithstanding the reasons given by Blackstone, all these offences were abolished by 7 & 8 Vict. c. 24, entitled, an Act for abolishing the offences of Forestalling, Regrating, and Engrossing, and for repealing certain Statutes passed in restraint of Trade. The English statutes which were repealed extended from the 51 Henry III. to the 5 & 6 Edward VI. c. 15.

FORESTRY or **FOREST SCIENCE** constitutes a separate and distinct branch of education, which originated in Germany from the increased scarcity of wood. In the forest academies are taught botany generally, mineralogy, zoology, chemistry, surveying, mensuration, mechanics, the methods of resisting the encroachments of sands, draining and embanking, together with the care and chase of game; and also the laws and regulations of forest administration. Germany is far in advance of other countries in the completeness and efficiency of its forest supervision. As far as possible property rights in forests are acquired by the government, or it is secured that forests shall be managed by government officers. The superintendence is conducted on scientific principles, the forests being surveyed, mapped, valued, and divided into blocks and complexes; working plans are then prepared for their management, after the most accurate and complete information has been obtained concerning everything in any way connected with or bearing on the forest in question; with regard to the timber itself, the soil, the climate, the temperature, the prevailing winds, the grazing practicabilities, legal rights, or any other of the many necessary details; and when once drawn up they provide for every contingency in the successful working of the forest for a long period of years with an accuracy, a perspicuity, and an attention to the minutest detail it would seem impossible to exceed. Even after acquiring rights, the government do all in their power to make the forest-lands generally useful. Where the growth of the trees places them beyond the reach of injury, cattle are freely admitted, and in all cases where it is practicable the woods are thrown open for recreation. The foresters, even in the lower ranks, are highly educated in their special line. They are not only at home in the more immediately practical branches, but they understand much about diseases and insect plagues, and the remedies for them, and are masters of mechanical woodcraft.

The forests of India extend over an enormous area, the population depending largely on these valuable resources. Inquiries made some years since showed that a system of wanton waste and destruction had prevailed, the ill effects of which could hardly be repaired in generations. The government then interposed, passed some stringent forest laws, organized a corps of experienced foresters, chiefly trained in the French Forest School at Nancy, to take the matter in hand, and to these the charge of our Indian forests is now confided, as also are the forestral domains of the crown, especially at Windsor and in the New Forest; but England still remains in a very unsatisfactory condition as regards training in the science.

The wood from forests is applied to the various purposes of housebuilding, shipbuilding, mill and wheel work, fuel, &c.; and the study of its fitness for these purposes forms a part of forest science.

The great pestilences which have for more than a quarter of a century so severely smitten two important sources of human food and clothing—the potato and the silkworm—have also been carefully studied, and with no small degree of success, by those who devote themselves to the science of forestry. A useful and interesting work on this subject is "The Forester," by Dr. James Brown, published in London in 1883.

FORESTS, FOSSIL. Remains of the growth of forests are found abundantly in the coal measures, and in most of the formations of stratified rocks of recent date. Several instances are recorded of forests having been submerged in historic times. Sometimes, as on the coast of Devonshire and on the shores of the Frith of Tay, they are exposed on the surface, stretching from high-water mark to far below the furthest limits of low water; or they are exhibited in section, as in the cliffs of Eastern Norfolk, where, resting on the chalk or crag, there is a stratum in which the stools and roots of the trees stand in their

natural position, the trunks having been broken short of and embedded with their branches and leaves. This stratum is covered with fresh-water beds and drift. Fossil forests contain trunks, stems, branches, and leaves of trees resembling those growing upon the land. The vegetable stratum is sometimes a bed of peat and moss. Geologists refer to the variation of the relative level of land and water as a cause that might produce this phenomenon; and Lyell mentions one instance where it might have occurred by the washing out and removal by the tide of a gravelly stratum supporting a peat bed.

FORFAR or **ANGUS**, a county of Scotland, is bounded east by the German Ocean, south by the Frith of Tay, west by the county of Perth, and north by those of Aberdeen and Kincardine. It lies between 56° 27′ and 57° N. lat., and between 2° 26′ and 3° 22′ W. lon. The greatest length, north to south, is about 36 miles; the greatest breadth, east to west, about 36 miles. The area is 890 square miles, or 563,266 acres. The population in 1881 was 266,360.

There are four natural divisions of the surface. The first is the Grampian district, which comprises somewhat less than the north-western half of the county, and exhibits a tract of irregular mountain ridges, which for the most part have a shallow moorish soil, and are covered with short heath and large tracts of peat moss; but numerous valleys by which they are intersected are fertile and picturesque. Some of the Grampian Hills exceed 3000 feet in height. The second division is formed by the great valley of Strathmore, or Howe (hollow) of Angus, which extends across the centre of the county from south-west to north-east. The third division consists of the Seedlay or Sidlaw Hills, which run parallel with the great chain of the Grampians, from the south-west extremity of the county. The fourth division is the maritime district, included between the Sidlaws and the shores of the Tay and the ocean. This tract is generally very fertile, under high cultivation, and adorned with numerous villages, plantations, farm offices, and elegant villas.

The Grampian Hills are of varied geological character. They consist of granite, having frequently topazes and rock crystal in their cavities and fissures; gneiss, with quartz, mica-slate, and garnets; limestone, large beds of slate, porphyry, veins of lead-ore. On the declivities of the Grampians are found slate, greenstone, basalt, limestone, sandstone, amygdaloid, and other varieties of rocks. In the Strathmore district, besides breccia, rubble-stone, and other soft strata, there was formerly a deep shell-marl, which was procured from beneath beds of peat-moss at the bottom of several ancient lochs drained chiefly for this purpose; namely, the lochs of Kinordie, Lundie, Logie, and Restennet. From the undrained lochs of Forfar, Rescobie, and Balgavies it was dragged up by means of iron scoops worked from boats, and was used for manure. It is not now so used, being nearly exhausted. Iron and pipe-clay occur in this district. The Sidlaw district is composed chiefly of sandstone interstratified with indurated clay, and covered with various kinds of basalt, greenstone, and porphyry; it contains in different spots deposits of limestone, sandstone, clay-marl, lead, and copper; and specimens are met with of quartz, jasper, agate, and onyx. The maritime district contains beds of sandstone and extensive quarries of limestone. Fragments of granite from the Grampians lie strewed about the lower ground. Coal of an inferior quality has been traced a little to the west of Arbroath. The poor, who cannot obtain coal without difficulty, procure fuel peat, brushwood, broom, and furze.

The soil, which is various, ranging from the finest alluvial to the moorish, rests mostly on the old red sandstone and the trap.

This county has about 40 miles of sea-coast. Formerly there were few parishes without a lake. The number is now much reduced. Some have been drained to gain an extent of arable land, but many more have been wholly or partially drained for the sake of the rich marl manure beneath their beds. The following are the principal of those which remain:—Loch Lee, Lintrathen Loch, Forfar Loch, Loch of Rescobie, and the Loch of Montrose. The chief rivers of the county are the North Esk, the South Esk, the Isla, the Dean, the Lunan, and the Dighty; none of these are large. Forfar is very well supplied with railway accommodation.

The most important rivers are:—the Isla, which rises in the Grampians, and after a south-east and south-west course of 41 miles, chiefly between the counties of Forfar and Perth, discharges into the Tay; the South Esk, which also rises in the Grampians and flows east through Strathmore, discharging into Montrose harbour after a course of about 40 miles; and the North Esk, which issues from Loch Lee and empties itself into the North Sea about 3 miles north of Montrose after a south-east course of about 25 miles. Numerous trees found in the mosses and marshy ground, consisting of enormous oaks, ashes, elms, and birches, indicate that formerly the lower part of this county was covered with forests. Some of the Grampian glens are partially clothed with oak and hazel coppices and natural birches; and others are covered with thriving plantations, but trees do not grow on the higher parts of the mountains.

The great variety of elevation in the maritime, inland, and alpine districts causes a corresponding variety of climate. On the high lands among the Grampians, where the snow lies on the summits during the greater part of the year, the air is generally cold and piercing. In the great midland valley, and in the sheltered parts of the maritime district, the climate is comparatively mild and genial. On the coast the easterly winds are occasionally very severe.

About a century ago a great proportion of this county was in the hands of a few ancient families; but since the introduction of trade and manufactures landed property has changed owners very frequently, and has become much more minutely divided and more equally distributed. The farms are generally of moderate size, and leased for nineteen years, and the farmers are men of skill, intelligence, and capital. Many farm buildings have been rebuilt and improved, and agriculture has probably advanced more than in any other county during the last fifty years. The land is now thoroughly well drained and manured, and the best and most improved implements are in general use. According to the last published official agricultural statistics there are 254,000 acres—or nearly half the entire area—under cultivation. The chief corn crops are oats and barley, and of green crops turnips and potatoes. The number of cattle in the county is 45,000, and of sheep 125,000. The ancient breed of horses in this county, commonly called garrons, is small but hardy, and capable of enduring much fatigue. They are still numerous in the Grampian district. Their colour is gray, and they feed chiefly on the stunted grass which they find on the sides of the mountains. The cattle were formerly diminutive, but have been wonderfully improved of late years, and large numbers are now exported. The original sheep were the small white-faced breed, and a few flocks still remain in the remote districts of the Grampians, but generally they are much crossed with the black-faced breed of Tweeddale. Game is plentiful; wild roebucks traverse the extensive plantations and glens of the Grampian and Sidlaw hills. The Alpine hare, whose fur in winter is snowy white, is found on the highest parts of the Grampians. Otters frequent the rocks on the coast; and during the fishing season porpoises frequent the mouths of the rivers, and destroy large numbers of fish.

Forfar is the chief seat of the coarse linen and jute manufacture in Scotland, which is carried on principally at Dundee and surrounding places. There are a large number of ironworks and engine factories at Dundee, and iron shipbuilding is also carried on in that town to a somewhat considerable extent. There are no mines in the county, but some extensive quarries of limestone, sandstone, and whinstone are worked. Both salt and fresh water fish are abundant, and the herring, cod, and ling fisheries employ altogether nearly 4000 hands.

In order to render the approach to the Frith of Tay safer, the magnificent Bell Rock lighthouse was built about 12 miles from its mouth. [See BELL ROCK.] The shipping trade of the county from Dundee, Montrose, and Arbroath has become very extensive.

Divisions.—Forfar is divided into fifty-five parishes. According to the Reform and Redistribution Acts of 1884–85 the county sends one member to Parliament, besides which two are returned for the burgh of Dundee, one having been added by the Scotch Reform Act of 1868, and one for the Montrose district.

Antiquities.—On the edge of a deep ravine stands that part of Brechin Cathedral which escaped the demolishing zeal of the reformers. It is partly formed into a commodious parish church. Close by, and joined by a passage, stands one of the curious round towers, of which (as stated in BRECHIN), though so common in Ireland, only one other specimen exists in Scotland, namely, at Abernethy in Perthshire. Next in dignity to the Cathedral of Brechin, but far surpassing it in magnificence and extent, was the monastery of Aberbrothwick, of which the ruins stand on a lofty position overlooking the sea. The priory of Restennet, of which the remains are on the lake of this name, near the town of Forfar, was a place of great strength, accessible only by a drawbridge.

Of the ancient vitrified forts, which occur in continuous chains along the heights of the northern parts of Scotland, there are three principal remains in this county. Hill forts are numerous; they all contain vestiges of rude buildings formed of loose uncemented stones, and are sufficiently large to have held the inhabitants of the surrounding district and their cattle, which in times of danger were driven therein. There are remains of several extensive Roman camps which formed a chain of military positions in a line from the south-west to the north-east sides of the county, including the towns of Forfar and Brechin.

Of baronial castles erected during the prevalence of the feudal system there are several magnificent specimens in this county, such as those at Broughty, Red Castle, Finhaven, Edzel, Invermark, Kelly, and Affleck. Various mounds, Druidical circles, cairns, and tumuli have been found. There is a considerable number of fine modern mansions.

FORFAR, the capital of the above county, and a royal and parliamentary burgh situated in the "Howe of Angus" or the valley of Strathmore, is 14 miles north of Dundee and 485 miles from London by the Caledonian Railway. It is a fairly built town, and its chief industry is the manufacture of coarse linens. The principal edifices are the sheriffs' court-houses, the county buildings, the town-hall, and several churches and chapels. It formerly obtained an infamous notoriety for its zeal against witches. The "bridle" which was used as a gag for the miserable old women who were burned is still to be seen.

Forfar is supposed to be the ancient *Orrea.* It was created a royal burgh about 1140, and at one time it was a place of royal residence. The population in 1881 was 12,817. Forfar unites with Montrose, Arbroath, Brechin, and Inverbervie in sending a member to the House of Commons. The bell of the parish church, which is said to be very fine in tone, has a curious history, having for long been a subject of dispute between the men of Dundee and the men of Forfar, in the course of which it lost its silver clapper, and originated the name given to a road known as the Forfar Loan, because before obtaining possession of it Forfar had to buy the ground it passed over between the quay and the boundary of Dundee. Forfar Loch, a piece of water lying west of the town, is also worthy of mention as containing a peninsula, which was long believed to be an artificial formation or "lake dwelling," but has since been proved to be formed by a natural strip of gravel. Before the level of the water was reduced by drainage operations it was an island, upon which St. Margaret had a residence.

FOR'FEITURE, the punishment by loss of lands, estates, rights, offices, or personal effects, which was formerly annexed by law to certain crimes, and also to certain illegal acts and neglect of duties in the holder of lands or offices.

Forfeiture is the French *forfaiture*, which is from the word *forfait*, a crime. The distinction between escheat and forfeiture is explained under ATTAINDER.

Forfeiture, in civil cases, takes place if a copyholder commits waste, or refuses to do suit of court, or grants a lease without license.

Forfeiture may also be the consequence of the breach of covenants between landlord and tenant, or persons connected in tenure, provided there be a condition for re-entry on the particular breach complained of. The right to take advantage of a forfeiture may be waived by any act of the person entitled which recognizes the continuance of the title in the particular tenancy; as, for instance, the receipt of rent by a landlord in respect of a time subsequent to the act by which the forfeiture is incurred, and that act was in his knowledge.

Land may be forfeited by alienation contrary to law, as by alienation in mortmain without license. In this case if the immediate lord of the fee, or the lord paramount, neglect to enter, the crown may.

Offices are forfeited by the neglect or misbehaviour of the holders; and the right to the next presentation to ecclesiastical benefices is forfeited by simony and by lapse. By the 33 & 34 Vict. c. 23, passed in 1870, it was enacted that no treason or felony should cause any forfeiture or escheat. The convict is left in possession of his property, but may be condemned in the expenses of his prosecution, and to compensate persons injured by his crime.

In Scotland the law of forfeiture proceeds on the same principles as in England. Thus a vassal or tenant failing for a certain time to pay his feu-duty or rent incurs forfeiture; and heirs of entail contravening its prohibitions as to alienation, &c., forfeit their rights to the next heir. Such forfeitures are termed "tinsels." Formerly a vassal who disavowed his superior, or encroached on his rights, incurred forfeiture. This, however, is now obsolete. The law of forfeiture for crimes has not yet been entirely assimilated to that of England.

FORFICU'LIDÆ. See EARWIG.

FORGE. A forge is literally a workshop, but is now limited exclusively to one where iron is manipulated. Many improvements have been introduced in recent years in the apparatus for forging or hammering heated iron. As is well known, a common smith's forge consists chiefly of a hearth, on which the burning fuel is placed, bellows for exciting the intensity of the heat, anvils on which to rest the heated metal while being forged, and hammers and swages to bring it into form. Since the introduction of the steam hammer all heavy forgings, such as the cranks of marine engines, &c., have been executed by it. Powerful forging presses on the hydraulic principle, capable of giving an enormous squeezing pressure, are now frequently used for moulding wrought iron, and for riveting.

FORGERY, from the French *forger*, to heat metal and hammer it, which is from the Latin *fingere*. From

this sense of *forger* came the meaning to make generally, to invent. Legal forgery is the false making, counterfeiting, altering, or uttering any instrument or writing with a fraudulent intent, whereby another may be defrauded. The offence is complete by the making the forged instrument with a fraudulent intent, though it be not published or uttered; and the publishing or uttering of the instrument, knowing it to be forged, is punished in the same manner as the making or counterfeiting.

It is by no means necessary, to constitute forgery, that the name of any person should be counterfeited, though this is the most common mode in which the crime is committed. A man is guilty of forgery who alters a deed for the purpose of defrauding other parties, though he signs his own name to the instrument; and it is forgery if a man, being instructed to make the will of another, inserts provisions of his own authority. The offence consists in the fraud and deceit.

At common law the crime of forgery was only a misdemeanour; but as the commerce of the country increased, and paper credit became proportionally extended, many severe laws were enacted, which in most cases made the offence a capital felony. But by the statutes 11 Geo. IV. and 1 Will. IV. c. 66, and other Acts, the punishment of death was abolished in certain special cases of forgery, and a punishment varying between transportation for life and imprisonment for two years was substituted; the death penalty was finally abolished by the 7 Will. IV. and 1 Vict. c. 84. The 24 & 25 Vict. c. 98 now governs all cases of forgery, and the punishment for the crime varies according to its seriousness. Certain classes of forgery (including the forgery of bills and bank-notes) are punishable with penal servitude for life as a maximum; some (including the forgery of debentures) by fourteen years' penal servitude; and others (including the forgery of documents to be used in evidence before a court) by penal servitude for seven years. The forgery of trade-marks is a misdemeanour, punishable with two years' imprisonment.

In Scotland the law applicable to forgery may be said to differ from that of England in little more than technicalities. The 24 & 25 Vict. c. 98 applies, however, to England and Ireland only.

FORK, an instrument divided at the end into two or more prongs, for various uses, from agriculture to the table. It is a strange fact that the use of any kind of forks at table was almost unknown till the fifteenth century, and they were then only known in Italy, which has the merit of this invention. Even when Heylin published his "Cosmography," in 1652, forks for the table were still a novelty. None of the sovereigns of this country had forks till after the reign of Henry VIII.; all, high and low, used their fingers. When introduced they came but slowly into common use, much prejudice being excited against them even by educated persons. Beaumont and Fletcher, and Ben Jonson ridiculed them in their plays, and one divine preached against their use as being an insult to Providence not to touch one's meat with one's fingers!

The general introduction of silver forks into Great Britain is quite recent; it can be dated no further back than the opening of the Continent to English tourists at the termination of the French war in 1814. Before that period forks were generally made of iron or steel. Electro-silver-plated forks are now in general use among the middle classes. They have all the desirable surface of silver, without being so costly. The Chinese still use sticks instead of forks. [See CHOPSTICKS.] They are made of ivory, and are often of fine workmanship, inlaid with silver and gold. Elsewhere in Asia and Africa, except among European settlers, forks are unknown.

FORM, in music, answers somewhat to design in painting, sculpture, and architecture. It concerns itself with the position of the main melodies or *subjects* of a work, with the relationship of the subjects to the *episodes*, and with the variety of the harmonies and of the keys into which the piece modulates. The chief forms in use are those of the FUGUE, the SONATA, the RONDO, the MINUET and TRIO (with which the march may be included), the SONG, and the VARIATIONS on an air. There are also compositions, such as the FANTASIA, which only regard form so far as it concerns balance of harmonies and of keys, &c., but which neglect it to a large extent as far as the recurrence of subjects and their contrast are concerned. These are discussed at length in the separate articles.

FOR'MA PAU'PERIS. By the statute 11 Henry VII. c. 12, every poor person having cause of action or suit shall have, by the discretion of the chancellor, original writs or subpœnas without paying for writing or sealing the same; and the judges of all courts of record where such suit shall be carried on are authorized to assign clerks to write for, and counsel and attorney to act for, such person without taking any reward. This indulgence is rarely refused upon petition, supported by affidavit that the petitioner is not worth £5 in the world after paying his just debts, exclusive of his wearing apparel and the right to the matter in controversy, and by a certificate by a barrister that he has good cause of action or suit. This statute extends only to plaintiffs in civil suits at law, but the courts of common law have a discretionary power to allow a party indicted to defend as a pauper, though without special cause shown the advantage is never given to a prosecutor. The Court of Chancery, to which the statute 11 Henry VII. does not apply, has from an early period permitted parties to sue and defend as paupers upon the same conditions as the courts of law, though in that court, it seems, if the party be in possession of the subject matter in dispute, and that should be worth more than £5, he cannot except it in his affidavit, and therefore will not be regarded as a pauper.

A person allowed to sue *in forma pauperis* pays neither for stamps nor fees to the officers of the court; but if he obtains a verdict with damages above £5, the officers take the fees. In case of improper or vexatious conduct on the part of the pauper, the courts will sometimes, though rarely, deprive him of the privilege, which is called dispaupering him.

By the rule 121 of Hilary Term, 1853, no person is now allowed to sue *in forma pauperis* unless the case laid before counsel for his opinion, and his opinion with an affidavit that the case contains a full and true statement of the facts, shall be produced to the court. The person admitted to sue shall not by the same rules be entitled to costs from the opposite party unless by order of the court, nor has he to pay such party costs.

In the devorce court the limit of property allowed to a person admitted to this privilege is £25, beyond wearing apparel, after payment of just debts.

In Scotland ample provision has been made to enable poor persons to sue and defend *in forma pauperis*. By the Scotch Act of 1424, c. 45, the courts are required, on being satisfied of the poverty of the applicant, and that he has a *probabilis causa litigandi*, to admit him to the benefit of the "poor's roll," the effect of which is that his cause is conducted gratuitously by the counsel and agents appointed for the poor, and that he is relieved from all court fees and charges. In criminal cases the trial cannot proceed until the court has provided the accused with professional aid if he desire it, and that altogether irrespective of whether he is rich or poor. As regards costs no distinction is made between cases on the poor's roll and those conducted in the ordinary way.

FORMATION, in geology, is the name given to a group of strata which have a large number of organic remains in common, and comparatively few that occur in the beds above or below. Thus among the fossils (nearly 1500

in number) in the beds grouped together as Devonian, only fifty-one species are found in the Carboniferous beds above, and only one (*Atrypa reticularis*) occurs in the Silurian beds below. The known stratified beds have been divided into three great groups (from their organic remains), the *Palæozoic*, the *Mesozoic*, and the *Cainozoic*. These great epochs are divided into formations: the Palæozoic into—(1) *Cambrian*, (2) *Silurian*, (3) *Devonian*, (4) *Carboniferous*, (5) *Permian*; the Mesozoic into—(1) *Trias*, (2) *Jurassic*, (3) *Wealden*, (4) *Cretaceous*; the Cainozoic into—(1) *Eocene*, (2) *Oligocene*, (3) *Miocene*, (4) *Pliocene*, (5) *Recent* or *Post tertiary*.

FORMIC ACID, or Acid of Ants (CH_2O_2). When these insects, especially the red ants, are irritated, they emit a sour fluid containing this acid. It is also a common constituent of the human body. It is usually prepared by the oxidation of starch. It is a transparent colourless liquid with a pungent odour and strongly acid taste, of specific gravity 1·235, and boils at 98·5° C. (209° Fahr.) It solidifies at $-1°$ C. in crystalline plates. It is extremely corrosive, and produces a painful ulcer when applied to the skin. It is a monobasic acid, having a great affinity for alkalies and metallic bases, and forming a number of stable salts known as formates, but none of any practical importance.

FORMIC ETHER. A number of formic ethers are known; the principal is the formate of ethyl ($C_3H_6O_2$) or formic ether; it is a colourless liquid, of a strong odour (resembling that of peach kernels) and aromatic taste. It is inflammable, burning with a blue flame. Its specific gravity is 0·915 at 65°, and it boils at 54° C. (132° Fahr.)

FORMO'SA (meaning "the Beautiful"), known in China as *Taiwan*, is an island which lies between 21° 58′ and 25° 15′ N. lat., and between 120° and 122° E. lon., and extends from S. by W. to N. by E. about 240 miles. Its width varies, but nowhere exceeds 80 miles, and the total area is 15,100 square miles. It is separated from the Chinese mainland by the channel of Fo kien, which is from 80 to 150 miles wide; and from the Bashee Islands by the channel of Formosa, 80 miles wide.

A bold range of volcanic mountains, some of which are 12,000 feet high, and are covered with snow for the greater part of the year, extends north and south through the island, dividing it into an eastern and western province. Their sides are clothed with fine trees and pasture-grounds, giving Formosa a very attractive appearance from the sea, whence its Portuguese name.

The mountains have a steep declivity on both sides, but on the west they terminate at a considerable distance from the sea, and so leave a wide undulating tract between them and the shore, which terminates in a low sandy beach. Rivers are numerous on this side; they are short but rapid, and bring down much earthy matter from the heights. The chief, Tan-shuy-khy, is navigable for junks to a considerable distance inland.

The sea around Formosa on the west and east is subject to very violent gales. In other respects the climate is very temperate, neither the heat nor cold being excessive on the plains along the western coast. The island is subject to earthquakes, which are sometimes very violent. In 1782 the whole lower portion was laid waste, and the sea inundated the country to the base of the mountains for twelve hours. A great part of the capital was destroyed, and some hundreds of junks were lost.

The soil of the lower tracts and the more gentle slopes of the hills is very fertile, and produces abundance of corn, rice of excellent quality, wheat, millet, maize, tobacco, cinnamon, pepper, and several kinds of vegetables. The fruits include the orange, pine apple, guavas, cocoa-nuts, and pomegranates, as well as grapes, peaches, and other European varieties. The sugar-cane is extensively grown, and tea, cotton, coffee, and silk are cultivated. Immense quantities of rice are annually exported to China, as are also sugar and camphor. Trade has made an enormous stride of late years, since it has been possible to carry on commercial intercourse with the island with some degree of safety. There are several open "ports," but they are for the most part shallow and inconvenient, and vessels generally have to lie off in the roadsteads. The annual value of the imports and exports amounts to about £1,000,000.

The domestic animals are cattle, buffaloes, horses, asses, and goats. The horses are small. Wild hogs, deer, monkeys, pheasants, and game are very abundant. Salt is made to a great extent, and, together with sulphur, forms a large article of export. Coal of excellent quality and petroleum exist in several places. A large quantity of sulphur is found, and is all appropriated by the Chinese government for powder manufacture.

The population, which is estimated at between 2,000,000 and 3,000,000, consists of Chinese and aborigines. The Chinese are only found on the west side of the island, where they first settled in 1662. They are mostly from the province of Fuh-keen, and have preserved their original habits and customs, and the spirit of industry and enterprise by which their countrymen are distinguished. The mountain district and the east coast are inhabited by a race called Pepo-hoans, who seem to be of Malay origin, but are taller and of a better type than the ordinary Malay. Among these there is a considerable number of Christians, who have pastors and teachers whom they support.

Formosa, together with the Pang-hoo Islands, composes a *fou*, or department, under the province of Fuh-keen, and immediately subject to its governor. It is divided into four *hiens* or districts. The capital, Taiwan, ranks among Chinese cities of the first class in the variety and richness of its merchandise and in population. It stands on the west coast, and is surrounded by a wall and ditch. Its principal streets are from 30 to 40 feet broad, and for many months of the year are covered with awnings to keep off the sun. On a small island opposite the city the Dutch, in 1634, built Fort Zealand, which commanded the harbour, the entrance to which is now choked up. The chief ports of the island are Takow, Tamsui, and Kelung, none of which possesses any adequate harbour accommodation.

The Chinese appear not to have been acquainted with Formosa till about 1430, after which its coasts became the resort successively of several Chinese pirates. The Japanese had planted colonies in the north, and at one period the greater part of the island belonged to them; but the Dutch, having been allowed to settle on the west coast, gradually dislodged all their opponents, including the Spanish and Portuguese (both of whom tried to gain a footing), and became sole masters of the island about 1632. After the conquest of China by the Tartars, in 1644, a Chinese chief, with an army of Chinese refugees, determined to conquer Formosa, and finally expelled the Dutch from it in 1662. In 1683, however, the new dynasty was overthrown by the continental Chinese, aided by the Dutch; and the authority of China has been ever since maintained over the island, though assailed by repeated insurrections. A British vice-consul is stationed at Formosa. Until recent years it was the custom of the Formosans to murder the crew and passengers of every vessel unfortunate enough to be wrecked on the coast. A number of shipwrecked Japanese mariners having been killed here in 1874, and the Chinese showing no intention of inflicting any punishment for the outrage, the Japanese took the law into their own hands, and landed a strong military force on the eastern coast. The savage tribes were chastised and reduced to submission, and the Japanese proceeded to introduce numerous features of that civilization in which they have themselves so largely advanced of late years. This aroused considerable jealousy at Pekin,

and the misunderstanding would have ripened into war but for the good offices of the British representative. The Japanese were induced in 1875 to leave Formosa, to the extreme regret of the natives. The latest reports convey hopes that the Chinese authorities have decided to pursue a more enlightened policy with regard to this island. A telegraph has been laid between Taiwan and Takow, improved roads have been undertaken, and other measures are in progress to develop its resources.

FORMO'SUS, one of the earlier popes, was bishop of Porto, and earned the honourable title of the "apostle of the Bulgarians" by his great labours among the Slavonic heathen. Nevertheless, in 878, he was involved in one of those sweeping anathemas which Pope John VIII. took pleasure in inflicting. Consequently when this tyrannical man came to a violent end in 882 (his brains were beaten out with a mallet by an assassin) there were not wanting those who accused Formosus as being privy to the plot. But the new pope, Marinus, held the good Formosus at his true value, and his first act was to free him from the ecclesiastical penalties he had so long borne, and to receive him into the greatest favour. It was Formosus who was selected to crown Pope Stephen V., one of the near successors of Marinus, in 891; and when Stephen died a few months afterwards, Formosus was at once elected pope by a powerful section of the church. The suffrages of others had fallen upon Sergius, who was actually at the altar preparing for his inauguration when the emissaries of his rival entered and tore him away by force. His partisans loudly protested against the Bishop of Porto becoming Bishop of Rome, in violation of the then existing canonical rule against the translation of bishops, and further they held Formosus as excommunicate, as suspected of murder, and as bound by an oath he had been made to swear never to resume his episcopal rank, nor to enter Rome, nor to aspire to more than lay communion. Evidently there was a severe struggle, and in the end Sergius fled to Tuscany. Not only was there discord in the church, but an Italian and a German candidate were in arms for the empire. Formosus threw in his lot with the German Arnulf, and suffered considerably when Arnulf's fortunes fell for a time. Eventually, however, Arnulf entered Italy for a second time and took Rome by assault; and again set Formosus over the revolted city, beheading the ringleaders of the opposite party, and in return receiving his crown from the grateful pope. Proceeding elsewhere in Italy on his career of conquest Arnulf was stricken with paralysis apparently, which was (as usual) attributed to poison, and he hastily returned to Germany. Nearly all Italy rose, and it would have probably gone ill with Formosus had he not died naturally just at this juncture, 896.

But though their enemy was dead the Italian party could at least resort to the dishonourable vengeance of insulting his corpse. Accordingly the new pope, Stephen VI., disinterred the body of Formosus, had it dressed in full canonicals, and in open council addressed it with the rebuke, "Wherefore, O Bishop of Porto, didst thou ambitiously usurp the see of Rome?" The defendant not answering was condemned, as of course, was stripped, the three benedictory fingers cut off, and the mutilated remains cast into the Tiber.

Time worked its revenges. The fishermen believed certain occurrences to be miraculously wrought by the body in the river; they therefore fished it up and carried it to St. Peter's Church for burial. To their amazement all the statues in the church bowed their heads as they passed by. At so stupendous a circumstance all doubt vanished. The angry and repentant people rose against Stephen, cast him into prison, and eventually strangled him in 897. His successor, Theodorus II., buried Formosus anew with every rite, and restored his memory by public honours; and John IX., who quickly succeeded Theodorus, formally condemned and annulled the impious council held over the dead body of Formosus by Stephen.

FOR'MULÆ, in chemistry, are either *empirical* or *rational.* The former gives the composition of the substance in the simplest possible form, in terms of the atomic weig[illegible] of the [illegible]nts [illegible] it, [illegible]d is fixed [illegible] invariable if the analysis be exact. The latter gives the composition of the substance as it combines with other bodies, and fixes its place in reference to these. The empirical formula for acetic acid is simply CH_2O, and is the same as lactic acid, methyl formate, and glucose, bodies of very different properties; its rational formula is $C_2H_4O_2$, and represents the form in which it enters into combination with bases. In many organic compounds there is great difference of opinion about the rational formula, which may be made to express different views on their constitution. The exact proportion of the different elements is easily ascertained; their exact arrangement is often exceedingly difficult to determine.

The empirical formula may be deduced from the ultimate analysis by dividing the proportion of each element in 100 parts of the substance by the equivalent of the element, and then reducing each to its simplest expression. The combining equivalents of acids are determined by the analysis of their salts. An organic base is examined by observing the quantity of an acid required to form with it a neutral compound.

The vapour-density, boiling or melting points, specific gravity, and combining equivalents are all studied in making out the rational formula.

FOR'RES, a town of Scotland, in the county of Elgin or Moray, situated 25 miles N.E. of Inverness, on a slight eminence formed by an old sea terrace and promontory, at the edge of the sandy maritime plain which forms the north part of the county. It is backed by fine wooded hills. It has an elegant town-house with a tower, several churches, one of which is dedicated to St. Lawrence the martyr, of whom an ancient painting is preserved at Brodie House, holding in his hand the gridiron on which he is said to have been roasted; a superior endowed school, a museum, mechanics institute, hydropathic establishment, &c. Findhorn is its port, and it belongs to the Inverness district of burghs. The most interesting ancient memorial in the town is Sweno's Stone. It is a sandstone pillar 20 feet high, carved with figures of warriors and animals. It is said to have been erected in the reign of Malcolm II. to commemorate the final expulsion of the Danes in 1014. On a hill above Forres there is a tower in memory of Nelson. The population of the parish in 1881 was 4752.

FORT WAYNE, also called *Summit City,* is an increasingly prosperous city of Indiana in the United States, situated at the confluence of the St. Joseph and St. Mary rivers, which here form the Maumee. It is 751 miles west of New York and is a great railway centre The Wabash and Erie Canal passes through it, and this together with the railway communication, affords great commercial facilities. Railway car works, planing mills, flour mills, tanneries, and a woollen factory, are its chief industries. It has numerous churches and educational establishments. In 1850 the town had only 4282 inhabitants; in 1880 the number had increased to 26,880.

FOR'TE, in music, means *loud.* It is the Italian for loud or strong. Usually the simple initial *f* is used as a contraction. Passages of less force are marked *mf* (*mezzo-forte,* half strength), and those of very great force *ff* (*fortissimo,* with greatest force). Sometimes *fff* is seen, as expressing the greatest force attainable. Beethoven is fond of the unusual sign *fp,* a forte note followed instantly by a piano note or passage; *sf* expresses a less vigorous variety of the same effect, and is the contraction for *sforzando, i.e.* "forcing" the particular note over which it is marked.

FORTEBRA'CCIO, BRACCIO, was the punning pseudonym of Braccio Montone, a captain of one of those mercenary bands of the middle ages who ever and anon carved themselves out principalities, some to pass away as quickly as they had sprung up, some to endure longer. This Braccio about 1420 occupied the greater part of the papal dominions. In fact Pope Martin V. at his accession owned not a single city in the papal territory. He endeavoured at first to set one of the famous captains against another, and to this end recognized Joanna II. as queen of Naples. This policy on the part of the pope, which was necessitated by his temporal needs, was the price at which Ludovico Sforza advanced against Braccio Fortebraccio as gonfalonier of the church, to drive him out of the patrimony of St. Peter. But Braccio of the Strong Arm was able to inflict a severe defeat upon Sforza, and the pope was forced to change tactics. He now induced Florence to invite the condottiere to a parley. Braccio delighted the gay city by his magnificence; feasting and jollity were the order of the day. The pope's adherents were. on the other hand, in bitter penury, and the Florentines taunted them with the contrast. (*Papa Martino non vale un quattrino* was the distich in all the children's mouths.) In Siena Cathedral is a series of frescoes illustrating the life of the arch-diplomatist Æneas Sylvius Piccolomini (Pius II.), and among them this meeting of Braccio Fortebraccio, though the future pope was then hardly more than a boy. The captain of the mercenaries restored Orvieto, Narni, Terni, and Orta, but retained Perugia, Assisi, Todi, and some other towns as a vassal of the pope. He also reduced Bologna for the pope into the bargain. Æneas Sylvius tells us that though so brave and strong he was palsied on one side—a resemblance to the historical (perhaps not real) figure of our own crookback Richard III.; and again like Richard, or rather as Richard is represented under his enemy and successor, he was plausible, eloquent, and full of a sarcastic and biting humour. His dashing chivalrous way seems to have made him popular among those over whom he held a not unkindly sway.

FORTH, a river of Scotland, formed at Aberfoyle by the Duchray and Dhu, which descend from the N.E. side of Ben Lomond; flows S.E. between the counties of Stirling and Perth, and past the towns of Stirling and Alloa. At this last town it begins to widen out into an estuary. Its whole length, with its windings or links, is 170 miles. Its basin is about 645 square miles. It is navigable for vessels of 300 tons to Alloa, and for those of 100 tons to Stirling. Its chief affluents above Stirling are the Teith and Allan, and below, the Devon and Carron. A canal, called the Forth and Clyde Canal, beginning at Grangemouth, connects it with the Clyde at Bowling, giving a continuous communication between the North Sea and the Atlantic. It admits vessels of 8 feet draught of water. The summit-level is 141 feet, and it has a branch to Port-Dundas on the north side of Glasgow, and is joined near Falkirk by the Union Canal from Edinburgh. The Frith of Forth is 11 miles wide at its opening opposite the Bass, and 6 miles at Leith. The tide ascends some way above Stirling.

FORTIFICATION, the art of strengthening, by material constructions, important points in an actual or possible theatre of war. The demand for its use may therefore occur either on the ground occupied by contending armies, in which case the works must necessarily be capable of more or less rapid execution, coming under the heading of *Field Fortification;* or prudence may dictate that nations shall prepare themselves in time of peace against invasion by constructing works of a lasting character on their frontiers and coasts, as well as on the main roads to the interior, and around their capitals and other important places, which may either be centres of commerce, depots for the supply of men and war material, or suitable places of refuge for armies that may be beaten in the field. Such works as these are classed as *Permanent Fortification;* they are armed with heavy artillery; and durable materials, such as masonry and iron, enter largely into their construction.

The simple principles which govern the whole art of fortification are—1st, to expose the enemy while covering ourselves; 2nd, to place obstacles in the way of his advance while under our fire. The first of these has gained in importance in proportion to the improvements in arms; not so the second, the application of which depends on the character of the defence, whether purely defensive or more or less accompanied by offensive counterstrokes. Here it may be remarked that, however advisable or necessary a purely defensive policy may be locally, decisive results can only be obtained by a vigorous assumption of the offensive, towards which ultimate object the other should always tend.

The various kinds of defensive works will now be shortly described under the following heads:—

1. Fortresses and forts.
2. Coast defences.
3. Attack and defence of fortresses.
4. Field fortification.

1. *Fortresses and Forts.*—The walls of fortified places in the middle ages consisted of curtains and towers (fig. 1, Plate I.); the curtains high enough to make escalade difficult, and with a width of 2 or 3 yards only at the top, made up of the battlemented parapet wall with a narrow path behind it; the towers higher and more massive, projecting in front of the curtain and flanking both the face and top of it. For a full and vivid description of mediæval fortification the reader is referred to "Military Architecture of the Middle Ages" and "Annals of a Fortress," by Viollet-le Duc.

To enable the defender to keep a better watch from the top of the wall and to shower down missiles on the ground at its base, it was usual also to build out on the top overhanging wooden hoardings, having holes in the floor; or stone projections, termed *machicoulis.* A ditch or moat usually completed the defences. The methods of attack in those days were either to scale the wall with ladders, this being rendered more easy by filling up part of the ditch, and using engines to throw heavy missiles to destroy the overhanging works; or, little wooden houses on wheels, called *cats*, were run across the ditch and against the wall to give cover to pioneers undermining the wall with picks and crowbars, or to battering-rams; or again, a wooden tower or *beffroi* of many storeys was made to overtop the wall and moved forward on rollers on a causeway across the ditch. From this the archers kept up a shower of arrows, and the men at-arms were landed on the top of the wall. Against a resolute defence these means were very inadequate, and the besiegers had often either to raise the siege or to rely upon starving out the garrison by a blockade, which the conditions of military service in those days made it difficult to maintain for many months. The feudal castles especially, from their strength and site, most often defied capture. Cities were more vulnerable. The two leading characteristics of mediæval fortification were the provision made for a step-by-step defence, and the defence of the foot of the wall from the top (*vertical* defence). With the introduction of cannon came the first great change. Towards the end of the fourteenth century "bombards," built up of bars held together by rings of wrought iron, were used, producing great effect on the walls wherever they happened to strike; but the bad powder and weakness of the guns made the shooting too uncertain for systematic breaching, and the fire was usually directed upon the gates; to protect these it became customary to throw up *bulwarks* or boulevards (German *boll-werk*) of earth and timber in front of them, and the arrow slits were enlarged for use as gun-ports.

Towards the end of the fifteenth century the improvements in artillery, coupled with the use of gunpowder for mining, brought about further changes. The walls were strengthened by ***ramparts*** (Fr. ***remparer***) of earth and arches behind them; deep ditches were dug in front to furnish banks of earth to protect them and to prevent mining by gunpowder; the bulwarks thrown up in front of the gates and of the towers began to be recognized as the best places on which to mount guns with which to oppose the besiegers' artillery and to flank the walls; in new works the latter were sunk beneath the ground, and the ditch became the principal obstacle. Step by step the general section of a fortified line arrived at that which is shown in fig. 1, Plate II. The rampart is chiefly organized for the service of heavy guns with which to oppose the besiegers' batteries, the slope of the glacis being so adjusted as to be swept by their fire. By means of banquettes provision is also made for musketry fire, to be delivered over the top or *crest* of the parapet, searching the *covered way* up to its inner edge. The glacis can also be swept by musketry fire from the covered way; the latter is useful as a starting point for patrols and sorties, &c., and the defenders communicate with the inner inclosure or *body of the place* (also called the *enceinte*) by means of steps and ***ramps*** or inclined roadways leading down into the ditches, and tunnels or *posterns* leading from the latter through the rampart into the body of the place. Guns deliver their fire either over the parapet (*en barbette*) or through channels or *embrasures* cut in it. Both of these methods are attended with disadvantages, the former exposing the guns and gunners too much, and the latter offering a good mark to the enemy and requiring constant repair. The Russians used at the siege of Sebastopol bullet proof mantlets of rope to protect the gunners from rifle bullets. To prevent the effects of *ricochet* or bounding fire (formerly used in the days of round shot) from the enemy's batteries raking or *enfilading* the ramparts in the direction of their length, shot-proof mounds or *traverses* had soon to be built across the terreplein of the rampart, one between every two or three guns. These are shown along the covered way in fig. 3, Plate II. When traverses are put up to stop fire from the rear, they are called *parados*. The plan or *trace* at first developed into that which is known as the "bastioned" system, *bastion* having become the name appropriated to the portions thrown out to flank the inner boundary. Thus in fig. 3 the fire from the flank *b c* sweeps the ditch of the face *e f* as well as that of the right half of the curtain *c d*. This figure further illustrates the manner in which the front *a b c d e f* is arrived at from the line *a f*, which is one of the original sides of the polygon drawn round the place to be defended.

Fig. 2, Plate I., gives an idea of the appearance of a town fortified in the simplest manner on this system, one of the oldest exponents of which was the celebrated French engineer Marshal Vauban (1633 to 1707), who repaired or constructed more than 160 places, took part in forty-eight sieges, forty of which he directed as chief engineer, without a single failure; twice defended fortresses; and was present in more than 130 actions. Figs. 5, 10, 11, Plate II., give illustrations of his method. Italian, German, Dutch, and French engineers all devoted themselves to elaborating improvements in this system for the fortresses which now sprang up all over the Continent; these improvements consisted chiefly in methods of protecting the flanks from being silenced by the enemy's artillery previous to the passage of the main ditch, and in providing inner lines or ***retrenchments*** to fall back upon after the failure of the outer (figs. 11, 12, 13). Nor was the bastioned system the only one which their ingenuity devised; there was the star or ***tenaille*** system (fig. 17) of the Marquis de Montalembert (1713–1799), an officer of dragoons in the French army, who perhaps contributed more new ideas to fortification than anyone else. His experience, gained in fifteen campaigns and nine sieges, led him to try to increase the power of flanks and to overwhelm the enemy's breaching batteries by a powerful artillery fire from guns in casemates (fig. 16). He also introduced a system which he called the "polygonal," the immediate parent of that which mostly obtains in the present day. The principle of this method consisted in securing the flank defence of the main ditch by a large masonry building or *caponier* in the centre of the front to be defended, having three tiers of vaulted chambers for guns, besides musketry loopholes. There was also a continuous mass of earth or *counterguard* beyond the main ditch, to protect the walls of the body of the place (see fig. 18). It would be impossible here to describe the endless varieties of form suggested by such great names as those of Coëhorn, Carnot, Cormontaingne, &c., but figs. 5 to 18 will give a rough idea of some of them. Fig. 3, Plate II., and fig. 19, Plate III., give on a larger scale examples of the later forms of the two great rival systems, the bastioned and the polygonal, of which the former was generally affected by the French engineers, and the latter was appropriated by the Germans, being sometimes called the German system.

The simplicity of the polygonal system gives it the advantage of being more readily adapted to irregular ground, while the flank defences are more secure from distant artillery fire than those of the bastioned system. It is also better suited to forts of small size. The objections urged against it are the vulnerability of the caponier by mining, and the isolation of its defenders beyond the main boundary. The caponier has to be sunk very low in the present day to protect it from curved fire. In both systems the approach to the *body of the place* is hindered by pointed works thrown out in front of the ditch, called *ravelins* (from the Italian *rivellini*, or scout works), which bring a flanking fire to bear on the lines of approach to the bastions, and must consequently be first taken. Frequently, in order to gain greater saliency or on account of the form of the ground, works are thrown forward on or beyond the glacis, sufficiently near the enceinte to be defended by its fire; these, called *advanced works*, assume various forms, such as *lunettes* (see fig. 23, Plate III.), *hornworks*, which were formerly much used, or *crownworks*. The hornwork consisted of a bastioned front at the head with sides or branches flanked by the work in rear; the crownwork had two bastioned fronts joined together in front instead of the single front. When points outside a fortress which it is important to occupy do not admit, owing to distance or to the form of the ground, of the works upon them being defended by the musketry of the place, those works must be provided with their own flank defences on all sides, and they then become *detached works*. To see large fortresses of the types just described we must go abroad, for the immunity from invasion of our own shores has happily rendered such works in time past unnecessary; only inferior instances of the bastioned system are to be found at our important dockyards, such as Portsmouth, Plymouth, Chatham, designed to protect them from attack from the land side.

But fortification has since 1815, and more especially since the introduction of rifled weapons, undergone further changes. It was seen that the detached works, which had always been necessary in special cases, gave great facilities for extending the outer boundary of a fortress sufficiently to enable it to hold an army, and thus become an ***intrenched camp***, giving a secure starting-point for operations against the enemy's field armies, or affording shelter to armies worsted in the field. The detached forts enable the place to be held by a small garrison against surprise or minor attacks, while at the same time they serve as nuclei or pivots, between which field troops may during a siege operate freely, supported by the artillery of the forts and

of the body of the place behind. The long range of modern guns gave a fresh reason for the use of detached works in order to provide against bombardment. Especially was this necessary in the case of dockyards like Portsmouth and Plymouth, from which the enemy should be kept about 5 miles away, which could only be done by a chain of forts. This idea was carried out at those places as part of an extensive scheme of national defence sanctioned by Parliament in 1860, the remaining works, consisting of coast and river forts and batteries, carrying the heaviest guns. More lately, the war of 1870 has shown the importance of a great development of defences in order to prevent blockade by a comparatively small force. The perimeter of the works of Paris was more than 30 miles when it was besieged in 1870; but this has been considerably more than doubled by the works since built, so that an enormous army would now be required to shut the place in (fig. 25, Plate III.) That war showed also that even with minor places every effort should be made to mitigate the convergence of the besiegers' fire by increasing the radius of the defensive works, and the long and successful defence of Belfort was due to the energetic adoption of this course. Strasburg (fig. 23) is a good instance of an old fortress with multiplied outworks and advanced works; Antwerp, of a new fortress provided with detached forts. In the days of smooth-bore ordnance it was necessary, in order to breach a wall, to place the guns in a battery quite close to it, on the glacis of the work; but nowadays a wall may be breached by heavy shells from a distance. The ditches of modern fortifications must therefore be made narrow and deep, and their escarps and caponiers sunk well below the level of the crest of the glacis (fig. 20, Plate III.) Escarps, such as that in fig. 4, Plate II., can now be easily destroyed from a distance.

Fig. 21, Plate III., shows the general shape of one of a line of modern detached forts, one of the principal features of which is the provision of large hollow traverses on the *terreplein* of the rampart to stop enfilading fire, and at the same time to afford covered places of shelter for light guns and men against shells. In places open to the enemy's view embrasures have almost disappeared, or at any rate are made as shallow as possible, as the old deep embrasures are too easily seen and destroyed by shells. The disappearing carriage offers the best simple solution of the difficulty, as iron shields and turrets are too costly for general use. Fig. 24 shows the construction of a caponier. The rear or *gorge* of the fort is closed by a bastioned trace. Such a fort may have a garrison of 500 to 1000 men, and be armed with from 25 to 50 guns; casemates are provided for the garrison under the rampart (fig. 4). In case of a siege it would be supported by its neighbours and by powerful intermediate batteries thrown up and armed as soon as the attack is foreseen. But to give time for the construction of such batteries it must itself be able, in spite of the heavy convergent fire of the field guns and guns of position, to arrest any advance of the enemy, and compel him to bring up a siege-train and to open trenches. The most essential point therefore is a good organization of the ramparts as an artillery position, combining freedom of action with the utmost attainable security for the guns, gunners, and ammunition. To give absolute security against bombardment the forts should be about 5 miles from the central point, so that the length of the chain for a complete circuit would be about 30 miles. If they are exposed to attack by the methods of the siege they should not be more than 1½ miles apart, so as to support each other effectually; but where it is enough that they should command the intervals between them with their fire, they may be placed in open country, 2 or 3 miles apart. The use of detached works as the principal scene of the struggle has lessened the importance of the inner enceinte of fortresses, and the system of multiplied outworks may be regarded as a thing of the past; indeed they may be sources of weakness rather than of strength. With weapons of short range the passage of the ditch was usually the stage in the attack which could be most obstinately and successfully opposed, and to accumulate outworks, each with its own ditch, was the best means of prolonging the defence. But now that fire at long ranges plays such an important part, outworks, while giving only a feeble fire themselves, would mask the fire of the more important works behind them, and therefore the enceinte in future will probably be of a simpler trace than heretofore.

Provisional Works.—It will frequently happen, especially in countries where permanent works have been sparingly provided, that when war is imminent the great strategic importance of some points that are not fortified will become apparent, and they must be prepared for defence in a few weeks' time; or permanent works may be in course of construction, and it may become necessary to complete them hastily; or during the progress of hostilities points may be occupied in the enemy's country which it is essential to hold securely with a small force: the term *provisional* is now commonly used to distinguish the character of the works constructed in such cases, which is, in fact, a compromise between that of field and that of permanent works, inclining to one or the other according to the importance of the point and the time and means available. In 1866 a very extended chain of works of this kind was thrown up around Floridsdorf, on the north side of the Danube, for the protection of Vienna, 7000 men being employed daily. A little later, when war had broken out and the Prussians had occupied Dresden, 6000 labourers were sent there from Berlin, and in a fortnight several detached forts and batteries were built. The leading distinction between provisional and permanent works is the use of timber, rails, and T iron in place of masonry, though the latter will not always be excluded. The profile or section will be less considerable, and the ditches being less deep the flanking caponiers will not be so well covered from artillery fire. Large use is therefore made of accessory obstacles, such as are used in field fortification, and the flank defence of the ditch is sometimes abandoned.

2. *Coast Defences*.—In no branch of fortification have the recent improvements in artillery produced greater changes than in that of coast batteries. The old masonry forts and martello towers can now be reduced to ruins in a very short space of time by ships carrying the heaviest guns made, and the introduction of the iron turret into naval construction has relieved the ships of much of the disadvantage under which broadside vessels laboured in not being able to deliver their fire except in the position which afforded the best mark to the enemy. Their vulnerable points are their decks, engines, and steering gear; to these may be added the circumstance that ships can carry no more armour than that for which they were designed, and every inch gained in the armour-piercing power of guns affects the vulnerability, and perhaps the question of the existence of many of the ships then afloat. The penetration of armour-piercing guns may be roughly taken as equal to the diameter of the bore at ranges between 1000 and 2000 yards.

Ships enjoy the advantage of great mobility, and, when several are acting in concert, of concentration of fire; but they are at best unsteady platforms upon which to work guns, and most British naval officers appear to be of opinion that their best tactics are to engage the batteries at as close a range as practicable, when the object of the operations requires that the latter should be silenced at all hazards; as, for instance, in preparing the way for a landing, securing an anchorage commanded by the shore batteries, or in a bombardment. But if the object be the passage of a channel, the ships may be quite content to leave the forts uninjured, if they can only pass them without injury to themselves;

in this their speed (perhaps a quarter of a mile in a minute) will assist them, and the few rounds that the batteries will be able to fire run all the greater chance of missing. Here the value of obstructions and submarine mines or torpedoes is evident.

The best and at the same time the cheapest mode of mounting the guns on shore is to distribute them in several batteries at a level of 100 feet or more above the water, engaging the ships from many directions at once, and at the same time themselves difficult to see. The earthen battery shown in figs. 29, 31, Plate IV., is suitable for this purpose. The gun fires over the parapet *en barbette*, and enjoys therefore a wide sweep. The *merlons* or masses of earth between the guns must be solid, and the wide spacing of the pieces which this necessitates (20 to 30 yards) renders these batteries unsuitable for very restricted sites. The parapet in front of the gun consists of earth and concrete, the latter inside. The guns, as is always the case with heavy artillery, are mounted on platforms fitted with trucks which run on iron racers, enabling the gun to be moved round to afford lateral range, while the special carriage to which the gun is fixed recoils on this movable platform, the recoil being checked by hydraulic buffers and other mechanical contrivances. The small *expense magazines*, holding about twenty-five rounds, which supply the immediate wants of the gun, are situated in the traverses, and the heavy shells are run out on small trucks very like those used by railway porters; they are raised by a small derrick on to a loading stage, running on wheels along a little railway passing round the front of the gun; from this they are raised to the muzzle (in the case of very heavy muzzle-loading ordnance) by means of a small derrick attached to the gun itself. The disappearing carriage gets rid of the evident exposure of the gunners which the above method entails, and as the gun can only be seen at the moment of firing, the enemy is much at a loss where to aim, and the battery may even be at a lower level. But there may be no ground giving the desirable command; or the high ground may be much retired from the water's edge, entailing loss of power from increased range; or the cliffs may be close to deep water, in which the ships could lie untouched by the guns, which cannot be depressed more than about 10 degrees; or again, dispersed batteries may be too open to attack from the land side, or the space too restricted to mount the necessary number of guns. In such cases the guns must be brought to the water's edge and placed in batteries of the strongest construction, thoroughly protecting the guns by means of iron shields, and giving cover overhead to the gunners as well. The spaces between the shields are closed either with earth and concrete, as in fig. 28, Plate IV., or if it is necessary to economize room, by solid masonry, as in figs. 27 and 30, the guns being arranged in one or more tiers. Figs. 27, 28, 29, being all drawn to the same scale, give an idea of the appearance of the batteries as seen from the front, as well as of the difference in the spacing of the guns required by the three methods. Masonry, however massive, is not proof against the continued action of very heavy shells, and when the importance of the situation justifies the expense, the fort may be entirely fronted with iron.

In *casemated batteries* the magazines are below, and the ammunition is hoisted up by lifts. These batteries offer an excellent target, and the effects of shells which may find their way in are proportional to the crowding of the guns, which are less than half as far apart as in the open batteries. The iron shield must not be dependent on the stone sides of the opening in which it is placed, but is bolted down to the base stones. Examples of all these types can be seen at Portsmouth and Plymouth. These are capable of resisting the heaviest guns afloat; but as the power of guns increases year by year, they have been designed in such a manner as to admit of extra thicknesses of iron being bolted on, thus defying artillery for some time to come. Fig. 26 gives an idea of the disposition of batteries to protect a channel.

Revolving iron turrets are the best of all means of protecting ordnance for coast defence, combining security with lateral range. Owing to their costliness they can, however, be only sparingly used—one of these may be seen at the head of Dover pier.

Channel obstructions must be placed under the effective fire of the guns, the efficiency of which they are designed to increase. They may be either *sunken* or *floating*. The former have been made of stout timber cribs filled with bricks, as used by the Confederates across the Savannah in the American Civil War; or of sunken vessels, as used by the Russians to protect the harbour of Sebastopol in the Crimean War; or of piles when the bottom is suitable; or of railway metals made into a chevaux-de-frise; or with heavy logs framed together, loaded at one end, and buoyed with barrels at the other, &c. *Floating obstructions* are more easily made and removed, and may consist of chains buoyed up by rafts, rafts of timber, or hawsers suspended from buoys, which would entangle themselves in the screws or paddles of vessels, the buoys being also connected by other ropes. These latter are very cheap and simple.

Submarine mines may be expected to be largely used in future wars between naval powers. They were employed by the Russians on a small scale for the protection of the Baltic ports in 1854, but their recent rapid development is due to the American Civil War. These mines are of two classes—those fired by mechanical and those fired by electrical means. Mechanical mines are self-acting; the touch of a passing vessel fires the charge, either by detonation or by a chemical fuze. Electrical mines can also be made self-acting when required, but in narrow channels they are so arranged that they can be fired by judgment from the shore. The firing of an electric mine is usually effected by the passage of the electric current from a voltaic battery through a short length of fine platinum wire, which it heats sufficiently to fire the explosive which is in contact with it. Mechanical mines are easily prepared, and require no special knowledge, and being in actual contact with ships at the time of explosion comparatively small charges are sufficient for them; but they are dangerous to handle, and a channel studded with them is impassable to friends as well as to foes—their removal also is attended with risk. Electrical mines have none of these disadvantages, and can moreover be continually tested after submersion by the passage of a weak current through them; they can also be made to signal the passage of a vessel over them at night or in a fog.

Submarine mines are usually placed in advance of passive obstructions, and well under the fire of the batteries (fig. 26, Plate IV.) Their general arrangement should be in lines to make it easier to fire them by judgment, and they should be far enough apart to prevent the explosion of one from damaging the others. The explosive at present used for these mines in England is compressed gun-cotton, which is easy of ignition and four times as powerful as gunpowder in proportion to its weight. Charges of 100 to 500 lbs. may be used, the latter for deep mines 40 or 50 feet below the surface, which are intended to destroy the ship by the straining of the hull due to the commotion of the water. There is much difficulty in keeping submarine mines in position in a strong tideway, or where the rise and fall of the tide is great, and in the latter case it is best to have several lines moored at different depths. Submarine mines may be attacked either by destroying them by countermines, which is a dangerous operation under the fire of batteries; or they may be searched for with grapnels at night.

3. *Attack and Defence of Fortresses.*—Some reference

has been made to the ancient methods of effecting an entrance into a fortress; these soon became impracticable on the introduction of fire-arms, and when a place was well defended it became necessary to gain ground under cover of trenches, so designed that the besieger could advance from his most distant positions without being seen. A regular siege is the last resource, when surprise or assault would be impracticable or too hazardous and costly, or when blockade or bombardment would be too slow and uncertain. Many of the smaller French fortresses surrendered to bombardment in the war of 1870; blockade or *investment* may be the most effective plan when a place containing many mouths to feed is known to be ill provisioned. In order to prosecute a regular siege successfully it is necessary first to invest the place completely.

The force employed in this operation (say about twice the strength of the garrison) will have to beat back the field troops from the positions which they will have taken up outside the fortress, and under its guns, which may take them some time to do. Energetic action at this stage is one of the best resources of the defender, and the successful defence of Belfort is a good instance of the delay which will be thus caused to the besieger. The latter will probably at last establish himself in an intrenched position about 2½ or 3 miles from the guns of the place, with outposts thrown out perhaps another mile. The intrenchments will be continually strengthened, so as to reduce as far as possible the number of men that must be taken from the active armies in the field. In addition to these fortifications to resist sorties it was at one time customary to make "lines of circumvallation" facing outwards to guard against attempts at relief. This is no longer done, it being found better to meet the relieving army in the open field, perhaps many miles away from the besieged fortress. The side of attack having been decided on, the besieger brings up siege-guns and places them in batteries, 2000 to 4000 yards away, hidden from view by accidents of the ground, and made without interruption, endeavouring by their fire to dismount the guns which bear on the field of attack, so as to admit of a long trench or *parallel* being opened at a distance of perhaps one-half to three-quarters of a mile (long rifle range) from the fronts of the fortress attacked. For its execution a large number of workmen are required, who are extended under cover of darkness and protected by a *covering* force of field troops thrown forward as close as possible to the place. The section of this trench is shown in fig. 34, Plate IV., and the positions of the first batteries in fig. 32, which is an actual instance from the Franco-German war of 1870–71. Communication between the parallel and the rear is maintained by zigzag trenches nearly similar to it in section, the prolongations of which pass clear of the besieger's works, so that he may not enfilade them. The batteries keep up their fire with energy, and the more distant guns, as well as fresh pieces, are brought up to a closer position, one half mile to a mile from the place, in order to insure better practice against the artillery of the fortress and to admit of further advance by trench-work. The duration of the exposure of the workmen may be lessened by the use of *gabions* (circular baskets without top or bottom), which they place in front of them in a line, and into which the earth is first thrown, so as to form a bullet-proof wall. As the works get nearer to the fortress, however, it becomes too hazardous to employ large numbers of workmen all at once, digging within close range of rifles; the trenches have to be continued therefore by the *sap*, in which one man (a trained sapper) works forward along the line of the intended trench, covering himself by a parapet as he advances, and followed by others who widen his trench and thicken his parapet (fig. 35, Plate IV.) This very slow process henceforward determines the rate of progress of the siege. As he approaches near the place the zigzags become so acute that recourse is had to a kind of key-pattern form, in which the directly advancing trench is protected by the parapet of the portion at right angles to it. When the outer edge of the ditch has been gained the counterscarp has either to be blown in or a passage made through it by mining. The escarp wall is breached by heavy shell guns at a range of about three-quarters of a mile, and when all is ready the assault is given. The further operations consist in making breaches in the inner works, and assaulting them under cover of as much fire as possible from advantageous positions, which have been gradually gained by sapping. Figs. 32, 36, 37, Plate V., are intended to illustrate the above description of the method of taking a place by siege. Fig. 39 gives a sketch of a breach. When a fortress is surrounded by detached forts it becomes necessary to take two or three of these by a process similar to that described, before making the advance on the "enceinte." The operation would be a heavy one, requiring a very large siege-train to oppose the numerous batteries which would be thrown up by the besieged between the forts.

The successful *defence of fortresses* consists in anticipating and being ready for all the movements of the besieger, holding the ground outside the fortress as long as possible, trying to discover the besieger's working parties by observatories, balloons, electric lights, &c.; harassing him and destroying his works by sorties; building plenty of casemated accommodation for the garrison, and strong traverses across the terrepleins of the works to protect the guns from enfilading fire, and to afford shelter for light pieces available for use at any moment to repel assaults and to fire on the heads of the saps. For the active portion of the defence the best-drilled and best-disciplined troops are required, capable of striking heavy blows with rapidity.

Mining will probably, owing to increasing difficulties of advance above ground, play a more prominent part in future fortress warfare than it has hitherto done; it was employed by the French at the siege of Sebastopol (1855), and was commenced by the Roumanians against the Grivitza redoubt on the east of Plevna in 1877. Most important fortresses are protected by systems of countermines in front of the projecting portions or *salients* of their prominent works. Owing to the extremely poisonous character of the gases produced by gun-cotton and other kindred compounds, gunpowder is the most suitable explosive for military mining. This difficulty, however, can in a measure be overcome by improved methods of supplying the miner with air, such as high-pressure pumps and knapsacks of compressed air carried on the person. Of all forms of warfare mining requires the greatest coolness and intrepidity, and must be undertaken by trained men. The general principle followed by the besieger is to explode large charges so as to create extensive craters, in which he obtains cover, and from which a further advance can be attempted; whereas the defender's policy is to destroy the attacker's mines by small charges, the effect of which will be felt underground only, and he will have the advantage of his existing system of countermines in the provision of many points to start from, thus saving time and enabling him to be beforehand with his opponent. Wood is the material employed for lining the shafts and galleries during the actual mining operations, but in the permanent system of countermines brickwork and masonry are employed. Fig. 38, Plate V., gives an idea of the character of such a system.

4. *Field Fortification* enables an army or other smaller force standing on the defensive to reap the full value of its arms, so that it may hold its ground against odds, or in its turn assume the offensive with a better chance of victory. A good general will, in the first instance, select ground which is naturally favourable to either of these objects, calling in the engineer to assist him where he may elect to stand on the defensive, but forbidding him to hamper those projected counterstrokes (either on a large

or small scale) which alone can be relied on to produce really decisive results. Thus, by economizing the portion of the force employed on the strictly defensive, greater numbers are available for assuming the offensive at the critical moment; and, which is most important, the defenders are enabled to hold a much greater extent of front than they could otherwise do with the same number of men. The celebrated lines of Torres Vedras are an instance of this. The English army, with its flanks resting on the Tagus and the sea, occupied with about 50,000 men a line of some 25 miles in length; it had its internal communications perfectly open; supplies were brought up from the sea, so that the defenders could not be starved out. The French general could not turn the lines, and they were too strong for him to attack in front: from those lines the tide of conquest of the French armies first began to recede. Field fortification came into general use at the end of the sixteenth and beginning of the seventeenth centuries as a result of the general introduction of fire-arms and abandonment of armour. At that time it was associated with more purely defensive tactics, one army seizing a position, inclosing itself within continuous lines of ditch and parapet, and the other watching it and afraid to attack. The very close range at which the decisive fire combat took place made flanking fire so important that the lines were broken up so as to provide numerous flanks, the tenaille and bastioned traces before alluded to being in constant use. The increased size of armies under Napoleon, combined with his peculiarly active strategy and the increase of good roads, brought intrenchments into disuse for a time, though it was the opinion of that great general that "those who neglect the support which the art of the engineer can give in the field gratuitously deprive themselves of a power and an auxiliary never hurtful, always useful, and often indispensable." Now again, in these days of breechloaders, the withering nature of infantry fire has brought into prominence the art of obtaining cover, especially hasty cover, such as can be improvised in a few hours. Of this description are the trenches shown in fig. 45, Plate V., and the carriage of light intrenching tools by the infantry themselves for the purpose of constructing them has become a necessity. Figs. 44, 46, also show the method of adapting hedges and walls for defence. Most battlefields of any extent will naturally lend themselves to a division into some portions suitable to passive defence, while other portions are suitable to counterstrokes; for the former, woods and villages and elevated positions in the line taken up will be occupied and made as strong as the time will allow, their strength being increased by obstacles under close range, such as entanglements of branches of trees and of wire, military pits, &c. (fig. 43). These fortified posts or *tactical pivots*, situated at intervals along the line, define the points of attack of the enemy, who, if he attempts to pass between them, will have to encounter their cross and flanking fire. The nearer they are to one another the better they command the intervals between them, but the less room is there for advance through those intervals, and the more men they absorb in the passive defence; and if the intervals be barred by obstacles detaining the attackers under flanking fire, a comparatively small reserve will be able to deal with those bodies of the enemy that may succeed in penetrating within the line. On the other hand a strong defensive force will desire more vigorous action and can afford to have these "pivots" fewer and further apart, thus reserving more force for action at any part of the line. The valiant defence of the farm buildings of Hougomont, which was slightly in advance of the British line at Waterloo, is an excellent instance of the value of such posts, which, combined with the action of the reserves, are the chief safeguards in the close fight. When, in the absence of villages, woods, &c., suitably situated, artificial inclosures have to be made, these are formed by earthworks or *redoubts* of as large a section or *profile* as time will permit. Their parapets are made from 8 to 15 feet thick in order to resist shells, and high enough to cover the defenders standing inside from view (figs. 40 and 48); they must also be liberally provided with *blindages* or *field-casemates*, which are excavations covered overhead with earth supported by timber (fig. 41), in which the garrison will be safe under the formidable fire of rifled artillery at long ranges, reserving themselves for the crucial moment of the infantry attack. These shelters are quite a characteristic of modern field-works, as illustrated in the Plevna redoubts, against which the Russian artillery was directed for hours in vain; the Turkish infantry suffered a very trifling loss, and remained unshaken for the close defence. Thus the phases of the combat for which fortification has to provide are—1st, for the preliminary cannonade; 2nd, for the infantry attack; and 3rd, for the close fight.

It may be necessary to occupy important positions some distance in front of the general line, but still under its long-range fire: these are called *advanced works*, and their rear will usually be left open or very lightly closed to deprive the assailant of cover if he takes them. In other cases there may be works behind the general line in case of the failure of any part of the latter; these are called *reserve works*. Field works, which have thick parapets all round capable of resisting artillery fire, are called *closed works*; those which have only light parapets or obstacles in rear are called *half-closed works; open works* are those which are quite open to the rear. They are besides distinguished by their shape—those which are intended to sweep the ground in front through about one-third of the whole circle have two or three sides, and are called in the former case *redans* or *flèches*, in the latter, *blunted redans*; those which sweep half the circle in front have four sides (two *faces* and two *flanks*), and are called *lunettes*; squares, pentagons, or hexagons are used to sweep the whole circle, the greater the angle of the figure the greater being the effectiveness of the fire at that angle. The square has the merit of simplicity, and was generally adopted by the Turks at Plevna; in those defences also obstacles in the foreground were entirely dispensed with, the defenders relying, and rightly so, on the power of their fire.

In order to develop a really formidable fire against an attack in great force it will generally be necessary to throw up shelter trenches in the intervals between the fortified posts and sometimes in front of them, to cover lines of riflemen as well as their supports, if these latter cannot obtain shelter from the inequalities of the ground; the field-guns are also run into *gun-pits* (fig. 42), or placed behind banks or *epaulments* to cover the gunners. Walls and hedges are also useful for this purpose, provided they do not interfere with a proposed line of advance. The trenches, gun-pits, &c., will be placed on the brows of slopes and other favourable places for seeing the foreground thoroughly. The lines of trenches should be as straight as possible so as to give a good fire direct to their front, because at the comparatively long ranges at which the fire-combat now takes place there will be little opportunity at first for cross or flanking fire as formerly. To rob the enemy of all cover, hedges, walls, ditches, and hollows parallel to the line will as far as possible be levelled or filled in for some distance to the front. The ground will often admit of two or three tiers of fire being used at important points, as at Plevna. In addition to the works above described it will be a part of the duty of the engineer to look to the free passage of reserves to the front, making rough roads, and levelling obstacles where necessary. Fig. 49, showing a portion of the line of investment round Metz in 1870, gives an example of the application of field fortification to actual ground, and serves to illustrate the principles above explained. When there is not sufficient time for strongly

fortified posts, hasty works only can be used. In this respect villages and farms and woods are much to be preferred to redoubts, which require much more time to complete, whereas the former, however short the time, can always be turned to account.

In mountainous and well-wooded countries, where the use of ordinary field artillery is difficult, much use may be made of defensible wooden buildings called *blockhouses*. Their walls are made of bullet-proof *stockading*, and loop-holed for rifles; the timbers may be either placed upright, touching one another, or they may be laid horizontally, as in the Swiss huts. The roof is composed of strong timbers covered over with earth; the interior is fitted up for habitation with guard-beds, &c. A ditch and obstacles outside prevent the enemy from closing. The instances to which field fortification may be applied in war are battlefields, lines of investments, defence of the ground round a fortress, intrenched camps, defence of the passage of rivers (*bridge-heads*) and mountains. In the two latter cases, if offensive operations are contemplated, the defences should inclose a considerable area of ground on the enemy's side of the natural obstacle, from which to obtain a fair starting point without the chance of being thrown back on the defile. If, on the other hand, it is merely required to bar the passage defensively, a position can be taken up encircling the outlet and commanding it with a converging fire. For detailed information on field fortification the reader is referred to the authorized instruction books on the subject. The remaining branches of the art will be found treated of in the "Text Book of Fortification and Military Engineering," used at the Royal Military Academy, Woolwich, from which much of this article has been gathered.

FORTROSE, a seaport and royal and parliamentary burgh of Scotland, in the county of Ross, on a gentle eminence on the north bank of the Moray Frith, nearly opposite Fort George, from which it is 2½ miles distant, and 10 miles north-east of Inverness. There is a regular ferry between Fort George and this burgh. Fortrose was formerly known by the name of Chanonry, so called from its being the chanonry of Ross. About a mile to the west stands the small town of Rosemarkie; and the two places were united by a charter granted by James II. in 1444, under the common name of Fortross, now changed into Fortrose, which charter was ratified by James VI. in 1592. Rosemarkie is a smaller place than Fortrose, but is reckoned the parochial capital, inasmuch as it is the site of the parish church. Fortrose possesses a volunteer hall, several churches, a mechanics' institute, a wooden pier about 720 feet long, and a good academy. There are no manufactures in the place, but the salmon and other fisheries give considerable employment. The population of Rosemarkie, in which Fortrose is included, in 1881 was 1357.

The Bishop of Ross resided at Chanonry, and was termed Episcopus Rosemarkiensis. This episcopal see was founded by David I. in the twelfth century. Only a small part of the cathedral now remains. Some of the bishops of Ross were men of literary eminence, particularly John Maxwell, author of "Sacrosancta Regum Majestas," who died in 1646, when archbishop of Tuam in Ireland. Fortrose unites with Inverness, Forres, and Nairn in sending one member to the House of Commons.

FORTU'NA was the goddess of luck, chance (*fors*), in the Roman mythology. Nothing is more surprising than the bare matter-of-fact way in which the Romans deified abstractions in this manner. Where with the Greeks whole crowds of myths and delightful fancies clustered round the god of the sky, the goddess of the dawn, round him of war or her of love, nothing ever grew round the purely Latin deities. What tales of the gods they required the Romans stole ready-made, as they stole their statues, their pictures, and the bulk of their architecture, from the Greeks. Sowing (Saturnus), field-labour (Ops), blossom (Flora), boundary (Terminus), health (Salus), harmony (Concordia), opening or commencement (Janus), good faith (Fides), good luck (Fortuna), such were the most sacred divinities of Rome, though the worship of the Greek gods ranked far higher in outward show and in nominal degree. The god of the main chance, or property, Herculus (afterwards ridiculously confounded with the Greek demigod Herakles), the god of trade, Mercurius, and the goddess of luck, Fortuna, were of all others those most widely worshipped by the commerce-loving Romans. Their little altars stood in every market-place; at Pompeii an altar of Fortuna yet stands by the side of a busy street. Here a hurried vow might be paid as the merchant passed to conclude his bargain, or might be paid at leisure. The street of Mercury and the street of Fortune, each with its shrine, were never far absent from the forum in any Roman town. One of the finest of the temples in the Roman Forum is that dedicated to Fortuna Virilis, where women especially paid their vows that they might have "husband's good-luck," that is, by the permanence of their charms of body and mind might ever retain the affection of their partners. The oracles of Fortune at Antium and Præneste were very famous.

The Greek Tuchê was to a less extent worshipped as goddess of luck. Hesiod fables her as the daughter of Oceanus. Poets and sculptors figured her with a rudder as if guiding the ship of life; or with a ball or a wheel, emblem of unsteadiness; or with the cornucopiæ of Amalthea, as bountifully and capriciously scattering gifts broadcast; and often she is blindfold, to show the curious impartiality with which she favours deserving and undeserving alike, or alike neglects them.

FORUM, a large open space in ancient Roman cities (corresponding to the *agora* of the Greeks), usually surrounded with public buildings, where the citizens met to transact business, and where, previous to the erection of basilicæ, causes were tried. From this last circumstance the word forum is used metaphorically for a place of justice. Originally the Roman forum was probably the public market. At first we know it was surrounded by the booths of butchers and such tradesmen; witness the tragedy of VIRGINIA, wherein the injured father was supplied with a weapon from one of these stalls wherewith to kill his ruined daughter. Afterwards these gave place to the great establishments of the merchants and money-changers, as the forum became the exchange. Other fora were instituted for market purposes—the *forum boarium* for cattle, the *forum piscarium* for fish, the *forum olitorium* for oil, &c.

The *Forum Romanum*, so celebrated in history, surprises the visitor to Rome by its smallness. It is not much over 200 yards long by 30 yards wide, and is roughly rectangular. Its length lies between the capitol and the direction of the arch of Titus (and of the Colosseum). It was surrounded by magnificent buildings, and contained the public tribune or *rostra* (so called because the beaks or prows, *rostra*, of captured ships ornamented it); and also the *umbo* or navel of the Roman territory, the supposed centre of the Roman world, whence all distances were measured, &c. The splendid temples of the forum; the great basilicæ or judgment halls of Julius Cæsar; the Sacred Way, which led by the forum up to the capitol, and was solemnly traversed by the state processions or the triumphs of victorious generals—made this place, so small in extent, the most revered spot in the world. (Later on the triumphal arch of the Emperor Severus also spanned the Sacred Way.) Here were held the public meetings, the comitia of every kind; here met the senate, in the *curia hostilia*, a building on its north side; here was spoken that oration of Mark Antony which changed the face of the world after the death of the great Julius. In fact, to recount the occurrences in the forum is almost to narrate Roman history.

But the narrow limits, though sacredly kept for meet-

ings, &c., were impossible for the increasing business of Rome, once started in her career of universal conquest and organization. Consequently Julius Cæsar built the *Forum Julii* to the northward, and successive emperors followed with successive fora, still along the same line, from east to west, and northward of the Forum Romanum. Thus we get the *Forum Augusti*, a temple of Mars which still remains; the *Forum Nervæ*, a few columns of which, half buried by the street, emerge to show how beautiful its architecture must have been; the *Forum Trajani*, a great part of which has been traced, and where still rises the famous Trajan's Column, &c. The celebrated triumphal arch of Trajan's Forum has disappeared, its spoils having gone to make up the arch of Constantine near the Colosseum. This was the most splendid as well as the largest of all the fora.

It became the custom of every city to have its forum, in imitation of Rome. Many of these are preserved even better than those at Rome, but the most perfect of all is that of Pompeii. Kept almost intact in its main features by its covering of ashes when it was overwhelmed in 79 by the eruption of Vesuvius, it has retained for us the skeleton of the ancient vigorous municipal life, the judgment halls, temples, altars, statues, exchanges, and shops; so that but a very small modicum of imagination is necessary to fill up the outline with the gay colours of life. A carefully planned series of festivals in 1884 did in fact restore for a few hours the very appearance of ancient life to this extraordinary spot. Trained actors in appropriate costumes filled the place of the old Roman crowd, celebrating now this act and now that of the bygone civilization. The greatest pains were taken to satisfy every demand of the antiquarian, and the result was most interesting.

FOS'COLO, UGO, was born at Zante about the year 1777, of a Venetian family settled in the Ionian Islands. When yet a boy he lost his father, and returned with his mother to Venice, whence he was sent to study at Padua. Having returned to Venice he published a tragedy, "Il Tieste," which was performed in January, 1797. In that same year the ancient aristocracy of Venice fell by the hands of Bonaparte, and Foscolo, who like others of his countrymen had expected the establishment of a new and popular republic, felt bitterly disappointed at the conqueror giving up Venice to Austria. He gave vent to his excited feelings in the "Lettere di due Amanti," afterwards published under the name of "Lettere di Ortis." This work had a prodigious success in Italy; but most of the editions omitted a letter dated 17th of March, 1798, in which Foscolo clearly expressed his opinion of Bonaparte's character. After various vicissitudes during the French campaigns in Italy, Foscolo was, in 1808, appointed professor of Italian eloquence at Pavia. A few months afterwards the chair of Italian eloquence was suppressed in all the universities of the kingdom of Italy, and Foscolo retired to Borgo di Vico, near Como. He was banished from Milan, but returned in 1813, and when the Austrians took possession of the city he drew up a protest in the name of the inhabitants of Lombardy addressed to the allied powers. In 1814 he repaired to Switzerland, where he resided for almost two years. Not finding sufficient encouragement in Switzerland for his literary labours as a means of subsistence, he came to England about the end of 1816, and was introduced to some of the best society of the metropolis; he formed literary connections and wrote articles both for the *Edinburgh* and the *Quarterly Review*. In London he published his "Ricciarda," the essays on Petrarch and Dante, which are among his best compositions, and other works. He died of dropsy on the 10th of October, 1827, at Turnham Green, and was buried in Chiswick churchyard. In 1871 his remains were removed to Florence, where they were buried with all honour in the Church of Santa Croce, not far from those of Machiavelli and Alfieri.

FOSS or **FOSS-WAY,** an ancient Roman road in Britain, which extended from the coast of Lincolnshire on the north-east, to the coast of Devonshire on the south-west. It is supposed to have derived its name from the circumstance of its having had a ditch (*fossa*) on each side, and appears, from a Roman *milliare* or mile-stone found by its side near Leicester, to have been formed, or at least improved, by the Romans in the reign of Hadrian, and probably at or about the time of that emperor's visit to Britain. It has retained its name among all classes of people better than any of the Roman roads.

FOSSA (Latin, an excavation), in anatomy, a cavity in a bone or muscle, &c., with a large aperture but no perforation. These apertures are distinguished by different names, usually expressed in Latin; as the *fossa lachrymalis*, or a depression in the frontal bone for the reception of the lachrymal gland; the *fossa ovalis*, or the oval depression presented by the septum of the right auricle; the *fossa hyaloidea*, or the cuplike excavation of the vitreous humour in which the crystalline lens is embedded, &c.

FOSSA'NO, a town of north-west Italy, in the province and 12 miles N.E. of Cuneo, on the Stura, and on a canal uniting the Stura with the Po. It is surrounded by old walls, is defended by a castle, and is well built, consisting of spacious streets and substantial houses, usually lined by arcades. Its chief building is a fine cathedral. Its principal manufactures are of silk thread and silk fabrics. Its trade is in silk, corn, &c. Population, 18,319.

FOSSIL (a word derived from Latin *fodere* [*fossum*], to dig), in geology, is a term which was originally applied to all substances of a mineral nature dug out of the earth; thus ores and minerals are spoken of in old works as fossils. At present, however, the term is restricted to the remains of organized beings, and to such mineral matters as owe their form to such remains, provided they be of at least prehistoric age. In spite of this narrowing of the meaning of the term, substances of very different nature are included under the head of "fossils." Amber (the gum of trees belonging to past epochs, chiefly Miocene), coprolites (the dung of extinct reptiles and fishes), and bone turquoise (odontolite), are all considered fossils; so are casts of animals or plants, the tracks and burrows of worms, the footprints of birds and reptiles, &c. In many cases the substance of the plant or animal has been completely replaced by mineral matter [see FOSSILIZATION], though the form is retained. But there are cases in which substances occur of organic origin more or less unaltered in chemical composition, but completely altered in form, and to these the name "fossil" is not applied. Thus diamond and graphite, both generally considered to be of vegetable origin, are not considered fossils; and many writers deny the name to coal and jet. The calcite composing the shell of a mollusc or foraminifer, if crystalline (as in the case of marble), would no longer be considered a fossil though its origin might be known beyond a doubt. Fossils are found in greater or less abundance in rocks varying very much both in degree of compactness and in lithological constitution. But they are only found in *stratified* rocks, that is, in rocks which have been deposited by aqueous action or result from terrestrial accumulations. Igneous rocks, and such stratified rocks as have undergone very great alteration (*metamorphic* rocks), contain no traces of organic life; even had such remains ever existed in them they must have been completely destroyed or rendered unrecognizable. The fossils found in each geological formation result from the forms of life existing during the deposition of that formation, except in a few rare cases, where they are derived from the waste of pre-existing formations; thus the "crag" of Suffolk contains a large number of fish remains which have been washed out of the London clay. The nature and value of the evidence afforded by fossils in geological history are treated of under GEOLOGY and PALÆONTOLOGY.

Different animals have very different chances of being preserved in a fossil state, for in order that they may be so preserved it is obvious that they must be entombed before decay or destruction, or if casts of them be formed in soft matter (such as clay) these casts must harden before any other force is brought to bear upon them, otherwise the impression will be effaced as easily as it was made. The sea is obviously the most effectual agent for preserving organic remains, and marine formations will nearly always most richly repay the collector, at least in number of individuals. Animals dying in the sea, or within reach of its action, would be gradually covered by the accumulation of mud, ooze, &c., forming, sometimes with great rapidity, at the bottom in a tolerably broad zone surrounding the land, and in this zone have been formed (in all probability) all so-called marine deposits. The estuaries and deltas of rivers are places where sediment is generally being deposited with tolerable rapidity, hence estuarine deposits may be expected to be rich in organic remains. But the chances of land animals becoming entombed before decay is exceedingly small; the shells of mollusca are occasionally preserved, and still more rarely tree stumps and roots. Where birds and land animals or plants have been preserved, it has generally been because they have either fallen into the sea directly, or have been washed down into it by rivers or floods. Cases of a number of fossils—fossil fish, for instance—crowded together occur locally, and recent observations throw some light on this phenomenon; such observations are—the effect of submarine volcanic explosions or sudden influxes of fresh water in killing marine organisms, and cases like that described by Dr. Leith Adams, in which parts of the coast in the Bay of Fundy was covered by dead fish thrown up by a storm on 24th September, 1867. Among exceptional cases of preservation may be mentioned—(1) the coating of objects by deposits from calcareous springs, (2) the preservation of animals engulfed in peat bogs, (3) the covering of vegetable and animal remains by volcanic ashes, (4) the filling up of caverns in which animals have died, or into which they have been dragged by beasts of prey.

Herodotus expressly notices the existence of shells in the Egyptian mountains, and several of the ancients refer to the entombment of shells in rocks and mountains, but none of them attempted any systematic work on the subject; and little or no attention was paid to it till the latter part of the fifteenth century, when some controversy took place in Italy. Leonardo da Vinci, at the end of the fifteenth century, maintained that they were true shells, and that the rocks containing them were once part of the sea bottom. In 1517 Fracastoro wrote a treatise on the shells found in excavating the mountains near Verona. Steno in 1669 and Scilla in 1670 wrote on the subject in Italy. Lloyd in England published his "Lithophylacii Britannici Iconographia" at Oxford in 1669. Kentmann in Germany made a collection of fossils which were described in 1565 by Gessner. Vallisneri and Calceolarius, in Italy, made collections in the first half of the seventeenth century; that of the latter was described in 1622. William Woodward began his collection in 1695, and bequeathed it to the Cambridge University. About the middle of the eighteenth century palæontology may be considered to have advanced to the rank of a science, and the appearance of Brander's work on Hampshire fossils ("Fossilia Hartonensia") in 1766 may be looked upon as the point from which palæontological research in this country dates.

FOSSILIZATION, the term used to denote the change undergone by the remains of animals or vegetables preserved in strata of past geological epochs. Occasionally plants and animals are preserved entire. Thus insects are found imbedded in amber of Miocene age; unaltered shells of later Tertiary age are found in many localities—in Suffolk and the Isle of Wight, for instance; the carcase of a mammoth was found in Siberia imbedded in ice and so perfectly preserved that the flesh was devoured by wolves, while the skin was left with the hair still attached to it. Generally more or less change has taken place when any organic substance has been long imbedded in a rock; this change may be partial or complete, and the original structure may be perfectly preserved or completely lost. As instances of partial change the following may be mentioned:—Peat and lignite are partially carbonized plant remains which generally have their structure well preserved; in coal and jet the change has gone much further, and the original structure is often lost. Again, the teeth of fish and the bones of reptiles and mammals are often found comparatively little altered. The shells of molluscs and the hard parts of corals frequently occur with the calcite composing them becoming crystalline in texture. Complete replacement is by no means uncommon; for instance, wood is found completely replaced by opal and hornstone, but with the structure so completely preserved that it is exhibited in section as clearly as in a recent plant. The wood opal of Antigua affords an excellent instance of this silicification. Moulds of plants and animal remains are frequently found, as, for instance, when clay or calcareous matter forms a hardened crust round an object of organic origin, and the object itself decays or is washed out. Thus cases have occurred of twigs, leaves, &c., falling into a "petrifying" spring which has deposited carbonate of lime round them, and which has remained as a hollow mould when the vegetable matter within has decayed away. Frequently such moulds become filled with foreign matter, which gives a complete cast of the animal or vegetable substance, but without in the slightest degree preserving its internal structure. Of this kind are the echini of flint found abundantly in the chalk, shells converted into hæmatite (found in Cumberland) or into calamine. Shells are also found completely converted into chalybite (*e.g.* Anthracosia and Edmondia) in the Carboniferous rocks of Scotland; amonites and encrinites into pyrites and marcasite (as in the Lias at Whitby and Lyme Regis, and the gault clay of the Weald), and wood into fluor-spar. The mineral which is most frequently found replacing organic substances is calcite (carbonate of lime); this is due to its wide distribution, and its solubility in water containing carbonic acid. Silica, generally as flint or opal, occurs with tolerable frequency as a petrifying material, especially in limestone formations. The following minerals have been found replacing organic remains (but cases of such replacement are very rare):—Celestine, barytes, zinc blende, gypsum, talc, galena, copper-glance, apatite, and cinnabar. Shells formed of an unstable variety of carbonate of lime called aragonite, isomorphous with calcite, are generally found converted into the latter substance.

FOSSOMBRO'NE (the ancient *Forum Sempronii*), a town of Italy, in the province of Pesaro and Urbino, on the Metauro, here crossed by a handsome bridge, 35 miles west of Ancona. It has a fine cathedral, several Roman remains, and extensive silk and woollen manufactures. The population is 9120. Near the town was fought, in 124 B.C. the great battle between the Carthaginians under Hasdrubal, the brother of Hannibal, and the Romans, in which the former were totally defeated and their general killed. Tradition has preserved the memory of the event in the name of a hill in the vicinity, called Monte de Asdrubale. This victory determined the fate of the long-contested struggle between the Romans and the Carthaginians in favour of the former. Fossombrone was destroyed by the Goths, and again by the Lombards, but rebuilt by the Malatesti. That family sold it in 1440 to the Duke of Urbino, with whose territories it was afterwards transferred to the se. of Rome.

FOSSOR'ES is a suborder of HYMENOPTERA, an order of insects so called from the burrowing or digging habits of most of the species composing it. The insects of this suborder are of two sexes, which are both furnished with wings. Among the wasps (Vespidæ), which are sometimes placed in this division, "neuters"—that is, undeveloped females—occur, as in other divisions of the Hymenoptera; the neuters of wasps are winged. In the Fossores there is no special adaptation of the legs to their burrowing habits. The basal joint of the hind tarsi is cylindrical and not dilated, as in the bees. The fore wings are not folded longitudinally. The ovipositor of the female forms a sting. In form these insects are usually slender and wasp-like. They never form societies. They burrow in rotten wood, in the stocks of plants, in the ground, &c., and deposit their eggs in the burrows, and with them a store of dead or paralyzed insects to serve as food for the larvæ on their emerging from the eggs.

In this suborder are placed the following families:—Mutillidæ, Scoliidæ, Sapygidæ, Bembecidæ, Crabronidæ, Sphegidæ (containing the common sand-wasps), and Pompilidæ. The true wasps (Vespidæ) should not be ranked in this division.

FOSTER, JOHN, a celebrated English essayist, was born in the parish of Halifax, Yorkshire, 17th September, 1770. He was educated for the Baptist ministry, and commenced his pastoral work at Newcastle-on-Tyne in 1792. He afterwards laboured in Dublin, Chichester, and Frome with but little success, and in 1806 he gave up the regular work of a minister. The same year he published his "Essays in a Series of Letters," the work on which his fame chiefly rests. The letters were addressed to the lady whom he afterwards married, and the essays, four in number, were "On a Man writing Memoirs of himself;" "On Decision of Character;" "On the Application of the Epithet Romantic;" and "On some Causes by which Evangelical Religion has been rendered unacceptable to Men of Cultivated Taste." This work was so favourably received that Foster resolved to devote himself to literature, and he commenced writing for the *Eclectic Review*, to which he ultimately contributed nearly 200 articles. In 1820 he published his "Essay on Popular Ignorance," which attracted great attention, and in which he urged the necessity of a national system of education. He died at Stapleton, 15th October, 1843. The "Life and Correspondence of John Foster," edited by J. E. Ryland, was published in two vols. in 1846, and republished in Bohn's Standard Library in 1852.

FOSTER, STEPHEN COLLINS, an American song writer. Though in no sense a skilled musician nor deserving the name of a composer, he yet claims notice on account of the extraordinary success with which he gauged the best musical taste and ability of the generally less-educated public of his day. He was born at Alleghany, Pennsylvania, in 1826, of a good family, and made his first hit with "Open thy Lattice, Love," when he was sixteen years of age. The simplicity of the song and its accompaniment brought it within the range of every one's power, and as the melody was pleasing it achieved a great success. Foster next associated himself with the negro melodists, then in the flush of their first popularity, and the celebrated "Old Uncle Ned," "Old Folks at Home," "Old Kentucky Home," "Nelly was a Lady," &c., came from his pen. No one cared to know the name of the writer of these simple pieces, but thousands loved them and sang them. For "Old Folks at Home" the fortunate writer received 15,000 dollars. With very uncommon versatility Foster kept touch with his public, and as taste and cultivation improved among those to whom he wrote, his own songs took a higher tone. The best of his later songs are "Old Dog Tray," "Willie, we have missed you," and the really charming part-song "Come where my Love lies dreaming," which must be allowed to rank as a piece of genuinely artistic writing of a simple kind. Foster died in 1864, probably without his name being known to one in 100,000 of those who made the songs he wrote almost a substantial characteristic of their day. Not only did they form the stock in trade of the negro melodists, but they invaded the streets on barrel organs and in bands; they gained a slender foothold now and then in concerts, and distinguished composers wove them into selections and fantasias.

FOTH'ERINGAY, a village of England, in the county and 27 miles north east of Northampton, with a handsome church, in which several of the Plantagenets are interred. It is 100 miles from London by rail, being 3½ miles from the London and North-western station of Oundle. Fotheringay Castle, where Richard III. was born and Mary Queen of Scots put to death, was demolished by King James, the son of the latter.

FOUCAULT, JEAN BERNARD LÉON, a most distinguished French physicist, was born at Paris in 1819. His father was a well-known publisher. His studies in various departments of science were most fruitful of important results. He early devoted himself to light, and especially to the perfection of the artificial electric light, constructing regulators for it, &c. In 1850 he began his famous observations on the velocity of light; and that which had before been a matter of closely reasoned inference was by Foucault's genius reduced to a simple observation. By means of mirrors of a peculiar shape, rapidly rotating at a known velocity, he measured most accurately this apparently immeasurably swift motion, reducing the previous estimate by a considerable amount. By 1862 he was able definitely to announce that velocity as 185,000 miles a second. In 1851 and 1852 he produced probably the most striking experiments of the age—nothing less, namely, than converting the inferred rotatory motion of the earth into a plainly visible phenomenon, first by means of the PENDULUM, and secondly by the GYROSCOPE, as detailed in those articles. England honoured herself and the remarkable philosopher alike by presenting him with the Copley medal of the Society of Arts for those wonderful discoveries, whose simplicity only adds to their beauty. Foucault was already a member of the Legion of Honour, and in 1862, upon his demonstration of the velocity of light, he received the grand cross; he was a foreign member of our own Royal Society, and received a number of marks of distinction in his own country. Many practical improvements in almost all branches of physical instruments, from the governor-balls of the steam-engine to the solar telescope, were constantly proceeding from the brain of this inventive genius. Foucault died of paralysis in 1868.

FOUCHÉ, JOSEPH, Duke of Otranto, minister of police under Napoleon I., was born at Nantes 29th May, 1763. The son of a sea captain, he was educated for the ecclesiastical profession, but abandoned it 1792, when he became a member of the National Convention. He professed the most extreme republican views, spoke and voted in favour of the execution of Louis XVI., and in 1793 was sent to reduce the royalist sympathizers of the department of Nièvre to obedience. Here he introduced a movement for the spoliation of the churches, suppressed the priests, and caused the words "Death is an eternal sleep" to be inscribed upon the gates of the cemeteries. In 1794 he was sent to Lyons to punish the royalists, a task which he executed with so much rigour that on his return to Paris he was elected president of the Jacobin Club. In 1795 he was denounced as a Terrorist and expelled the Convention, and for a short time placed under arrest. In 1799 he was placed at the head of the police, a congenial position, and one for which he was peculiarly fitted. Cool, sagacious, determined, and utterly unscrupulous, he so perfected a system of espionage that he was able to exert

a greater influence over the internal affairs of France than any other man of his time. Fouché retained his office under the consulate, but was deprived of it by Napoleon in 1802. Perceiving the ambition of the latter Fouché determined to assist him in his designs, and in this he succeeded so well that after the coronation of Napoleon in 1804 he received the double appointment of minister of police and minister of the interior. In 1809 the emperor conferred on him the title of Duke of Otranto, together with large grants from the revenues of the Neapolitan territory, but in 1810 he lost the favour of Napoleon and was forced to resign. In 1813 he was appointed governor of the Illyrian provinces, and after the battle of Leipzig he was sent to Rome to watch the movements of Murat. After the first abdication of Napoleon, Fouché recommended him to abandon Europe for America, but on the return of Napoleon from Elba he again accepted the ministry of the police. After the battle of Waterloo Fouché placed himself at the head of the provisional government, and as he had previously opened negotiations both with the royalists and the allies he was enabled to bring about the capitulation of Paris and obtain from Louis XVIII. the reappointment to his old office. In 1815 he was sent as ambassador to Dresden, and after the passing of the law of January, 1816, which banished all those who had voted for the death of the king, he retired to Prague. He became a naturalized Austrian subject in 1818, and died at Trieste, 25th December, 1820. A man of immense ability, and concerned in all the important political movements of the period during which he lived, he appears to have been destitute of every motive save that of self-interest, and at the close of his career he had completely lost the confidence of all parties in the state. Napoleon, after his final banishment, spoke of him as "a miscreant of all colours," while the verdict passed upon his career by M. Thiers is that he was completely "indifferent to good and evil." A work entitled "Mémoires de Fouché, Duc d'Otranto," edited by A. Beauchamp, was published at Paris in 1824, which, though pronounced by the sons of Fouché to be a forgery, is generally regarded as being founded on original sources of information.

FOU'LAHS or **FOU'LHAS**, a nation widely spread along the western coasts of Africa, occupying the countries north of Cape Palmas as far as the banks of the river Senegal. They are of middle size, well made, and very active. Their skin is of a light copper colour, and their faces of a form approaching nearer to those of Europe than any of the other tribes of Western Africa, the Moors excepted. Some are heathens; but many are Mohammedans, and send their children to schools, in which they learn to read and write. They speak a peculiar language, differing from those of the surrounding nations.

FOUNDATION, the lower part or courses of the basement walls or piers of a building. In foundations it is of the utmost importance to prevent the settlement of the walls in an unequal manner; this can only be done by making the earth on which the foundation is set equally solid throughout its whole extent.

The breadth of a substructure should be proportioned to the weight of the superstructure. Nicholson, in his "Architectural Dictionary," says, "If the texture of the ground is supposed to be constant, and the materials of the same specific gravity, the breadth of the foundation will be as the area of the vertical section passing through the line on which the breadth is measured."

Concrete composed of gravel or shingle and hot lime is often used to form a solid bearing for the footing of foundations. The greatest care and judgment are required in making foundations for heavy superstructures; for if the piles should be of a bad quality, and the ground in which they are driven of an unstable nature, accidents and insecurity will be the inevitable result.

FOUNDING, one of the mechanical arts which embraces all the operations of reducing ores, and of smelting and casting metals. There are various branches of the art, and some difference prevails in the minor details of the processes, as in iron, brass, and bronze founding, in casting guns and cannon, types for printing, and bell-founding. The art has been known and practised from the earliest ages.

Founding is practised either in casting any quantity of metal in the solid, or with a core (by means of which the metal is preserved of a determined thickness or substance), or in plain casting. When an object is to be cast in metal, a pattern of that object is first made in some material sufficiently soft to be easily reduced to the required form by ordinary hand-cutting tools. Various substances are employed, such as clay or wax, or sand with clay, wood, stone, or any other material. Upon those models *moulds* must be made; these are commonly composed of plaster of Paris mixed with brickdust, sometimes sand, or sand with a mixture of cow-hair. For moulds for iron or brass work a yellowish sharp sand is preferred, which is prepared by mixing it with water, and then rolling it on a flat board till it is well kneaded and fit for use. Sands suitable for founding are readily procurable in Great Britain, but in some continental works the sand required has to be brought from a long distance. The same sand is used continuously, the broken moulds being thrown into a receptacle from which the sand required for new moulds is taken. A portion of fresh sand, however, must be added from time to time to the old, or else it becomes difficult to work. If the object is cylindrical, or of a form that admits of it, it is moulded finely in two pieces; these two parts are then carefully joined together, and the edges or seams cleaned. For the smaller class of works, instead of running the metal at once from a large furnace, earthen crucibles are used, into which the metal is thrown in small pieces; the crucible is placed in a strong heat in an air furnace, and as the metal is melted and sinks, more is added till the vessel is full. It is then lifted out by means of iron tongs adapted to the purpose, and the metal is poured from it into the moulds, in which channels or ducts for receiving it have been previously made. The soft metallic alloys, such as pewter, Britannia metal, &c., are cast in brass moulds. Type metal is generally cast in steel moulds by means of machinery.

In noticing the different ways of casting mention has been made of one in which a core is used. The *core*, as its name denotes, is a part or portion situated within the body of the cast; and its purpose is to form a centre to the work, by which the thickness or substance of the metal may be regulated. In coring, the mould must first be made complete; into this clay or wax, or any other fit substance or material, is then squeezed or pressed in a layer of uniform thickness; in large castings it is usually from half an inch to an inch thick. This layer represents the metal. The mould, if in parts, is then to be put together, the above-mentioned layer being left within it, and into the open space in the centre a composition (usually of plaster of Paris with other substances mixed with it) is introduced, and made to adhere to the clay or wax, or rather is filled up to it. This is the core, and it is often made to occupy the whole interior of the mould. When this is *set*, or dry, the mould is taken to pieces, and the material which has been made to represent the metal removed. The mould is then again put carefully together round its core or nucleus, the two portions being secured from contact by stops and keys properly arranged for that purpose. The mould and core are dried to dissipate moisture, and large moulds are strengthened with iron hoops. Channels or ducts are made for the entrance of the melted metal; and others are also made for allowing the air to escape as the melted metal enters the mould; these are

called vents. The usual method in great bronze works is to bury the mould in a pit a little below the level of the furnace, and by ramming sand firmly round it, to insure its not being affected by any sudden or violent shock, or by the weight of metal running into it. When everything is ready and the metal found to be in a state fit for running, the orifice or mouth of the furnace (which is usually plugged with clay and sand) is opened, when the metal descends, and in a few minutes the mould is filled. The metal is allowed to run till it overflows the mouths of the channels into the mould. The work is then left to cool, after which the mould is scraped or knocked off, and the cast undergoes the necessary processes (such as cleaning, chasing, &c.) to render it fit for the purpose designed. Large bells and statues are cast in this way.

Where a hard surface is required in iron castings a portion of the mould is made of cast iron, so that the molten metal is rapidly cooled or "chilled" at that spot. The armour-piercing shells made at Woolwich arsenal have their points hardened by this means, the body of the projectile being allowed to cool in the ordinary way.

By a process invented by Sir Joseph Whitworth, in which an enormous hydraulic pressure is brought to bear upon metal while in a molten state, an exceedingly strong and tough material can be obtained. Steel cast in this way has been used in the construction of artillery, and it is used in England for the manufacture of the Whitehead and laboratory torpedoes.

FOUNDLING HOSPITALS are charitable institutions, which exist in most large towns of Europe, for taking care of infants forsaken by their parents, such being generally the offspring of illegitimate connections. These institutions date from the middle ages, and were established for the purpose of preventing the destruction of children either by actual violence or by exposure in the streets or highways.

In France the philanthropist Vincent de Paul, the founder of the Society of the Missions, in the first half of the seventeenth century, exerted himself to found an hospital for infants, which were at that time frequently left to perish in the streets of Paris. It was at first supported by private subscriptions, but afterwards was made a national establishment—"Hôpital des Enfans Trouvés." Similar institutions were founded in other parts of France, and there are now altogether upwards of 140 in that country. In Paris, however, the name of "Enfans Trouvés" has for some years been changed to "Enfans Assistés." Admission is by personal application of the parent, followed by a strict investigation on the part of the police. But the Paris foundling hospital differs from the English in that the mothers can reclaim their children, and they are only supposed to deposit their infants in the care of the state—for it is a government institution—not to abandon them altogether. Hence the name "Enfans Assistés." In Spain the number of foundling hospitals is about seventy, and they are more or less general in all other Roman Catholic countries in Europe. Many Protestant countries have also established foundling hospitals—that at Amsterdam, where about 3000 children are annually received, being the most famous. The foundling hospitals of Moscow and St. Petersburg are among the largest in the world. There are none in the United States, but they exist in Mexico and nearly all the states of South America.

The foundling hospital in London was established in 1739 by Captain Thomas Coram, a benevolent sailor, whose experience of London was in his frequent journeys between Rotherhithe and the city. His compassion being aroused by the great rate of mortality among exposed and deserted children, he determined to found an institution in which, under certain circumstances, illegitimate children might be received and cared for. The theory of Captain Coram was that some system might be devised by which a double object should be attained—of "hiding the shame" of the mother and "preserving the life of the child." Those, however, to whom the benevolent captain confided the carrying out of his idea so far misapprehended his object, that the charity soon became known as an indiscriminate receptacle of abandoned children. At that time any person who brought a child was directed "to come in at the outward door and ring a bell at the inward door, and not to go away until the child is returned (diseased children were not admitted) or notice given of its reception. But no questions whatever will be asked of any person who brings a child, nor shall any servant of the house presume to discover who such person is on pain of being discharged." As the hospital became more extensively known, the numbers of applicants were enormous. Disgraceful scenes of fighting and scrambling for admission often occurred, in the course of which the weakest went to the wall; modest and unassuming women lost their chance, brute force prevailed, and the charitable object was wholly defeated. To obviate this scandal mothers were required to attend personally, and the assembled children were indiscriminately balloted for. No test, however, was applied to ascertain the deserving nature of the case; and considering that his advice was thus being disregarded, and his leading principle neglected, Captain Coram severed his connection with the hospital. Fifteen years after its opening the governors found it necessary to apply to Parliament for assistance; and chiefly through the influence of George II. it was conceded in such liberal measure that it was thought all comers could henceforth be received. Nursing establishments were formed in various parts of the country; a basket was hung outside the hospital gate, and an advertisement publicly announced that all children under the age of two months tendered for admission would be received. The result was that on the 2nd of June, 1756, the first day of such indiscriminate reception, the basket at the gate was filled and emptied 117 times. Fraudulent parish officers, married women who were perfectly able to maintain their offspring, parents of depraved and abandoned character, basketed their babies by hundreds. During the three years and ten months of the existence of this system, there were dropped into the hospital basket 15,000 children. The difficulty of properly feeding and caring for such a number was so great, that the death-rate among the children received was actually more than 70 per cent. Parliament now interposed, stopped the indiscriminate admission, and left the hospital to its own funds. It was then decided that every child who should be mysteriously presented, with a hundred pound note attached, should be received. This most reprehensible practice actually continued until the beginning of the present century. In January, 1801, it was abolished, and the existing rules of admission were substituted, the principal of which are:—

Children can only be received into this hospital upon personal application by the mothers.

No application can be received previous to the birth nor after the child is twelve months old.

No child can be admitted unless the committee is satisfied, after due inquiry, of the previous good character and present necessity of the mother, and that the father of the child has deserted it and the mother; and also that the reception of the child will, in all probability, be the means of replacing the mother in the course of virtue and the way of an honest livelihood.

The children of married women and widows are not admissible.

The object of these rules (careful personal inquiry being made into all matters) is as much to effect the restoration of the mother to society as to provide for the child—the philanthropic object of the founder being in this way far more fully carried out now than in his own time. On

leaving her child the mother receives a certificate numbered or marked, so that the authorities of the hospital may, if requisite, recognize the child, and a corresponding mark is attached to the child's clothing. The child may be restored at a future time if the mother can give satisfactory proofs of her ability to keep it, but this claim is of rare occurrence. As soon as the children are admitted they are baptized by the chaplain, and names given them from a list prepared by the treasurer. They are then sent into the country under the charge of wet-nurses, who keep them until able to walk. They then receive an excellent education in the institution, and are generally apprenticed, the girls to domestic service at the age of fifteen, and the boys as mechanics at the age of fourteen; some of the boys, having a knowledge of music, volunteer into the bands of the army and navy. If from any infirmity or deformity a foundling becomes incapable of labour, he or she is maintained during life out of the funds of the hospital.

FOUNTAIN, a jet or jets of water, flowing either naturally out of the earth, or from structures formed by art. Artificial fountains consist of water flowing from statues, vases, or architectural buildings, combined with sculptured figures and other ornamental decorations. At Pompeii not only the streets, but even the private houses were often decorated with fountains. At Rome the proper distribution of the rivers which flowed through her aqueducts was a matter of great importance, intrusted to the care of an officer of very high rank. The aqueducts were each charged with a certain number of pipes of supply, and no new pipe could be inserted without a special application to the emperor. Those whose means of interest were insufficient to obtain a private pipe were obliged to fetch water from the public fountains.

Some of the cities of Italy and the East are adorned with fountains, which are no less agreeable to the eye than useful to the inhabitants. Many of the fountains of Rome are highly decorated, of great magnitude, and vary much in their mode of pouring forth the waters with which they are supplied.

The city of Paris is well supplied with fountains, many of which are elegantly designed. The fountains of Versailles and St. Cloud in France, and those at Wilhelmshohe near Cassel, are the largest in Europe. The fountains at Chatsworth and the Crystal Palace are the finest in England, and are remarkable for the great height to which the water is thrown. London has no fountains worthy of notice except the two large ones in Trafalgar Square, supplied from a deep artesian well.

FOUQUIER-TINVILLE, ANTOINE QUENTIN, the notorious public prosecutor to the revolutionary tribunal of Paris during the Reign of Terror, was born at the village of Hérouel, in the department of Aisne, in 1747. Originally an attorney, at the outbreak of the Revolution he became known as one of the fiercest of the democrats, and was appointed by Robespierre first a member, and afterwards the director and public prosecutor of the tribunal at Paris. He held this office from the 10th of March, 1793, to the 28th of July, 1794, carrying out in a cool, determined, remorseless manner the bloody orders received from the Committee of Public Safety. Friends and benefactors received as little consideration from him as his enemies, and he kept the guillotine supplied with a constant succession of victims—Danton, Robespierre, and St. Just being among the number. He was himself imprisoned and tried in his turn, and being condemned was guillotined 8th May, 1795, shrinking from his fate with much terror.

FOUR HUNDRED, COUNCIL OF THE, was the oligarchy established at Athens by the *coup d'état* of Peisander in 411 B.C. These Four Hundred were representatives of a body of FIVE THOUSAND selected citizens; but the latter was merely a blind to conceal the true nature of the revolution, and the Five Thousand were never named. Their first proceeding was to expel the old senate by force. They still showed a firm front against the Spartans, who were at the time beleaguering Athens, although at the same time they made vain overtures of peace to the Spartan king. But the great Athenian colony of Samos, inflamed by some severities necessarily inflicted upon the democrats by the new oligarchy at Athens, called Alcibiades (then in exile) to its assistance, and organized itself for determined resistance. This gave a centre for rallying, and the internal disputes for precedence and power, always rife in an oligarchy, allowed the citizens in a very few weeks to overthrow the Four Hundred and to re-establish the democracy upon the basis of the Five Thousand selected citizens.

FOURIER, FRANÇOIS CHARLES MARIE, a celebrated French socialist, was born at Besançon, 7th April, 1772. He received a good education at the college of his native town, and afterwards travelled in France, Germany, and Holland, carefully and closely observing the social and economical condition of the different populations. On the death of his father he inherited a modest competence, which, however, he lost when Lyons was besieged by the troops of the Convention in 1793. He afterwards served two years in the army, and on his discharge obtained employment as a merchant's clerk at Lyons. Subsequently he started on his own account as a broker, and being satisfied with a very small income, was enabled to devote a considerable portion of his time to the study of the problems connected with social life. His first work, entitled a "Theory of the Four Movements and the General Destinies of the Human Race," was published at Lyons in 1808, but for a long time it attracted very little notice. Continuing his studies he published, as his means permitted, sundry other works on social subjects, among which may be enumerated his "Treatise on Domestic and Agricultural Association" (two vols., Paris, 1822); "The New Industrial and Social World," in 1829; and in 1835 his "False Industry and the Antidote." His writings gained him numerous disciples towards the close of his life, and in 1832 one of them made an attempt to carry out his principles by establishing a socialist community. This resulted in failure and disappointment; but Fourier, in no way discouraged, waited patiently till the end of his days for some rich men to make further experiments. He died at Paris, 8th October, 1837.

The system of society designed by Fourier has for its foundation the conception that attractions and repulsions form the governing forces of all nature, and that as in the material world these produce harmonious arrangement, so when free course can be obtained for them, they will do the same for human society. He imagines that if the desires and passions of man can have free scope the result will be happiness and virtue, and that the misery and vice which now prevail are brought about by the innumerable restrictions imposed by society upon human desires. In the place of the present order, Fourier proposed that men should be divided into small communities of 400 families, or about 1600 persons each, such a division being termed a *phalanx*. Each phalanx should inhabit a common dwelling or phalanstery, which should be provided with workshops, studios, &c., and surrounded by a sufficient space of arable land. The profit made by the united industry of each community was to be divided into twelfths, five of which were to be given to labour, four to capital, and three to talent. Private property was not to be abolished; but, on the other hand, every member was to have in any case a sufficient subsistence provided for him. Marriage as an indissoluble union of two persons for life he proposed to abolish, and to reorganize in an elaborate manner the family and the relations of the sexes. To most people who first approach Fourierism this part of the scheme appears revolting, but it must on no account be

understood that Fourier, any more than Plato (who advocated similar views), had any idea of vicious indulgence. He attacks the family because it is a selfish institution. By the economies of united living he supposed the expenses for necessaries would be much less than at present, while the co-operative principle of industry would increase fourfold the products of civilization.

In his writings there is very much that is fantastic; but many things which at first shock the reader are perfectly logical deductions from the central idea of the phalanstery as replacing the family. Nearly all men regard the family as a sacred institution, and it is certain that Fourierism will never prevail against so cherished, and on the whole so beneficent a system.

There have been one or two attempts since his death to establish a phalanstery, but as might be expected of anything so antagonistic to all usual societies, they have utterly failed. On the other hand, it must be admitted that Fourier has pointed out with great force and clearness many defects in the present condition of human society, and that he anticipated many of the modern co-operative arrangements of industry. In both ways he has been the cause of thought being directed to these points, which not only has already done good, but in the future will do far more good.

FOURTH, in music, is the interval contained by the extremes of four consecutive letters (as A to D, B to E, &c.), whatever their quality. [See INTERVAL.] For the restrictions as to the use of the Fourth in composition see HARMONY.

FOW'EY, a town and seaport of England, in the county of Cornwall, situated on the west bank of the river Fowey, near its mouth, having a convenient harbour. It is 25 miles S.S.W. of Launceston, and 285 miles from London by the Great Western Railway, being 4 miles distant from the Par station. It stands in the midst of scenery of singular beauty, but the town itself is built in a straggling manner, and the streets are narrow. There is a spacious market-house, with a town-hall over it. The parish church dates from about 1466. The chief business of the town consists in catching and curing pilchards, which, with china clay, stone, and copper ore, form the chief exports. The harbour admits vessels at all states of the tide. It was formerly guarded by two square forts (one, still standing, on the Fowey, the other on the Polruan side), between which, as at Portsmouth and other harbours at the same period, a chain was stretched. The guns of Fowey helped Charles I., who was here in 1644, to deny the harbour to the Parliament; and repulsed an attack by the Dutch in 1667. On a pile of rocks, on its west side, are the ruins of St. Catherine's Castle, built in the reign of Henry VIII. The number of vessels registered at the port in 1883 was 140 (16,000 tons). The entries and clearances average 2000 (200,000 tons) per annum. The name Fowey signifies the cave or quick river. It was a place of great importance in the thirteenth and fourteenth centuries, having numerous ships and a formidable name in the naval annals of that time. It sent forty-seven vessels and 770 men to the siege of Calais by Edward III. in 1347—being a greater number than was sent by any other town in England. It was burnt by the French in 1457, and taken by Fairfax in 1646. It formerly returned two members to the House of Commons, but was disfranchised by the Reform Act of 1832. The population in 1881 was 1656.

FOWL strictly means a flying creature, hence a bird, as is shown in the Old English form *fugel*, with the verb *fleogan*, to fly, and the modern German *vogel*. In the Authorized Version of the Bible this word is frequently used as equivalent to bird, and in this sense it is not quite extinct. Generally, however, the designation fowl is restricted to a few species of game birds (GALLINÆ) forming the genus Gallus, from one of which the domestic fowl is descended. In the genus Gallus the bill is moderate, strong, convex above, curved towards the point, naked towards the base, and furnished with two pendent and compressed caruncles or wattles. The head is surmounted with a fleshy crest or comb. The tarsi in the males are furnished with a long and recurved spur. The tail is composed of fourteen feathers, forming two vertical planes with the backs of the feathers towards each other; the two middle feathers in the male are elongated and curved. The males are polygamous and will not endure a rival. The superior adornment of the male sex which obtains in the genus, though not to so marked a degree as in other members of the same order, is explained by Darwin ("Descent of Man") in his theory of SEXUAL SELECTION. The genus Gallus belongs to the extensive family Phasianidæ, which contains besides the true pheasants, the peacocks, guinea-fowl, and turkeys.

Four distinct species of this genus are recognized. The Red Jungle Fowl (*Gallus bankiva*) is the species from which all the domestic races have sprung. It is an inhabitant of Northern India and Burma, the Malay peninsula, and the surrounding islands. In its plumage it closely resembles a black-breasted red game fowl. The resemblance in general structure and voice between *Gallus bankiva* and the game breed is extremely close. The comb is much developed, with deep lobes along the upper ridge. The head, sides of the neck, and back are covered with long loosely-webbed feathers, the *hackles*, of a brilliant golden orange colour. The upper part of the back below the hackles is bluish-black; the middle and lesser wing-coverts are rich deep chestnut, the greater coverts are steel-blue, the secondaries the same, with a broad chestnut border, and the primaries brownish-black, edged with pale reddish-yellow. The tail is black, richly glossed with green and blue. The under parts are black. The crow of the red jungle fowl resembles that of the bantam. It breeds freely with our domestic poultry, and produces fertile offspring. The kulm fowl, formerly described under the name *Gallus giganteus*, and standing more than 2 feet in height, is now regarded as a tame variety of *Gallus bankiva*.

The Grey Jungle Fowl (*Gallus sonnerati*) extends over the southern part of India. This is a fine bird, equalling in size one of our common domestic fowls. It has a large bright red comb, finely serrated. The general colour of its plumage is a golden or reddish-orange, with the breast and wings blackish-gray and the tail deep green. But its most singular character consists in the dilatation of the apices of the shafts of all the long hackles into flat elliptical plates. On the neck these are of a golden-orange colour, while the barbs are gray, so that this part appears covered with golden spangles on a gray ground. This species crosses with domestic fowls, but the hybrids are nearly always sterile.

The Fork-tailed Jungle Fowl (*Gallus furcatus* vel *varius*) has the comb entire without dentations, and the throat is adorned with a single large wattle springing from the centre. The head, neck, and upper part of the back are covered with feathers, which are not hackles. In the plumage green is the predominant colour. It inhabits Java and several of the islands to the east of it. The *Gallus æneus* of Temminck is not a distinct species, but a hybrid between *Gallus furcatus* and a domestic fowl.

The fourth species of the genus Gallus is *Gallus stanleyi*, peculiar to Ceylon. The cock has a yellow comb with a red edge; the under parts of his body are red. The crow of the cock differs altogether from that of any domestic cock. The hybrids between the two latter species and the domestic breeds are always infertile.

The fowl appears to have been domesticated in the East at a very early period. It is not mentioned in the Old Testament or in Homer, and was probably introduced into Europe from Persia, for Aristophanes ("Birds") calls it the Persian bird. The fact that the cock was sacred to the god of healing, Æsculapius, is interesting in reference to

the last words uttered by Socrates:—"Crito, we owe a cock to Asclepios, neglect not to pay it." Fowls were also domesticated by the Romans, the epicures appreciating the delicacy of their flesh, and all classes enjoying the sight of two cocks fighting. COCK-FIGHTING was also practised by the Greeks. Fowls were reared in Britain before the Roman invasion, but, according to Cæsar, for pleasure only,

there being a religious objection to their use as food. The Romans introduced the sport of cock-fighting into England. The game cock is the breed which was used in this sport.

The principal breeds as given by Darwin ("Animals and Plants under Domestication") are as follows:—

1. *Game breed*, the typical breed deviating only slightly from the wild parent-stock, *Gallus bankiva*. Game cocks are notorious for their pugnacity; the instinct to fight is so strong that whole broods, scarcely feathered, have been found stone-blind from fighting. This pugnacity is also displayed by the hens.

2. *Malay breed*, also remarkable for pugnacity. These fowls are large, with head, neck, and legs elongated. The comb and wattles are small.

3. *Cochin* or *Shanghai breed*, with short tail and wings, thick legs covered with feathers, short thick spurs, and well-developed comb and wattles. The Cochins are as remarkable for their quiet peaceful disposition as the game fowls for their pugnacity. This breed is valuable on account of its fecundity.

4. *Dorking breed*, another valuable breed of English origin. These fowls are large, and have a square compact body. The feet have an additional toe. The comb and wattles are well developed.

5. *Spanish breed*. The comb is very large and deeply serrated; the wattles are also of great size. The Spanish fowls suffer much from frost. The eggs are large.

6. *Hamburg breed*, of moderate size. The comb is flat, produced backwards, and covered with numerous small points.

7. *Crested* or *Polish breed*. The head has a large rounded crest of feathers. The comb is either absent or small and crescent-shaped; the wattles are often replaced by a beard-like tuft of feathers.

8. *Bantam breed*, originally from Japan. The bantams are chiefly remarkable for diminutive size coupled with great pugnacity.

For a complete treatment of the question of the origin of the domestic breeds of fowls, the reader is referred to Darwin's "Variations of Animals and Plants under Domestication" (vol. i. pp. 225–275). As regards the treatment of fowls in the poultry yard, the proper food, the diseases to which these birds are liable, &c., see the article POULTRY.

FOWLING, the act or art of taking birds with nets, by shooting, snares, the use of bird-lime, or other devices. It is also sometimes used for the taking of birds with hawks and falcons, more properly called FALCONRY. In Latin this sport is termed ***aucupium***. It is sometimes practised as a sport or recreation, but oftener as an employment by poor people, who follow this mode of gaining a livelihood with great danger and toil. This is particularly the case with rock-fowling, which is extensively carried on in Norway, the Faroe Isles, Shetland Isles, and the north of Scotland. The objects of pursuit in these places are sea-fowl and geese, which live among the rocky precipices and crags of the coast.

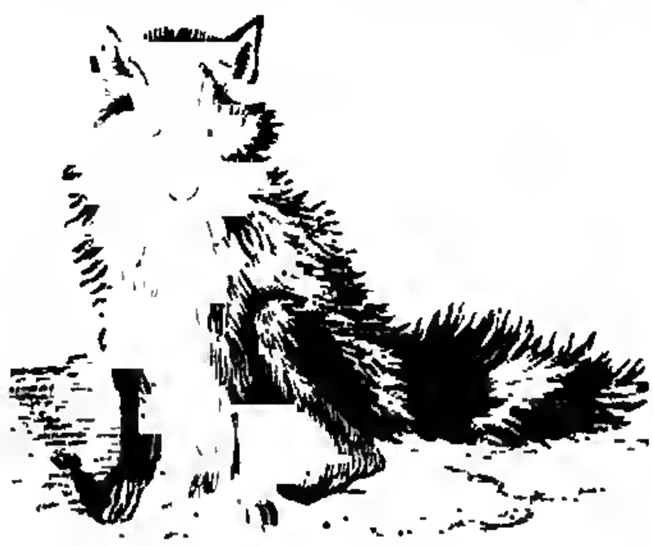
FOX (Vulpes) is the generic name for a section of the family CANIDÆ, or Dogs, distinguished from the restricted genus Canis by the pupils of the eye being linear when contracted by day, by the peculiar sharpness of the muzzle, the length of the body, and the bushiness of the tail, and by nocturnal habits. These are trivial characteristics, and in South America there are some forms which take an intermediate place between the dogs and foxes. Many zoologists therefore do not consider the distinctions between dogs and foxes to be of generic importance, and retain the latter in the genus Canis. A more important distinctive character of foxes than those above mentioned is the absence of frontal air-sinuses, which are present in dogs and wolves.

The Common Fox (*Vulpes vulgaris*) scarcely needs description. It measures about 3 feet, including the tail or "brush," which is a foot in length. The fur is reddish-brown above and whitish beneath; the tip of the tail is white; the back of the ears and the front of the legs are black. It has a gland under the tail which secretes a very fœtid substance, the odour of which enables the hounds to track the fox across country. The sharp muzzle, the shrewd look, the penetrating eye, the triangular pointed ears, and the cunning step, are all well-known characters of the little animal whose subtlety and address have been for long proverbial. The familiar English name *reynard* is derived from the French word for fox, *renard*. The fox inhabits a burrow, known to huntsmen as an "earth." This burrow he sometimes excavates for himself, but usually prefers taking up his quarters in a rabbit's or a badger's burrow, after ejecting forcibly the rightful owner. The extent of reynard's depredations on the farmyard is a matter of history. He devours in his nightly excursions rabbits, hares, pheasants, game of all sorts, poultry, and eggs. Robbers, however, like beggars, cannot be choosers, and reynard at times has to satisfy himself with such "small deer" as rats, mice, and even beetles. Occasionally he varies his diet with fruit, as the fable of the fox and grapes shows. The common fox is spread over the greater part of Europe. Many well-marked varieties, some of which are often regarded as distinct species, occur in Europe, Asia, North Africa, and some parts of America. In most parts of England this animal is protected for the sake of FOX-HUNTING. The female goes from sixty to sixty-five days with young, and produces, generally in April, from three to five at a birth. In North America the common fox is represented by the red fox (*Vulpes fulvus*). This species, though it agrees in general manners with our reynard and is larger, possesses neither the wind nor the same powers of endurance. It runs for about a hundred yards with great swiftness, but its strength is exhausted in the first burst, and it is soon overtaken by a wolf or mounted horseman. The fur of the red fox, from its softness, smoothness, and depth, is valued as an article of commerce.

Foxes of various gradations of colour, called Cross Foxes, are very common in the far countries of North America; these are considered by Sir J. Richardson to be

only varieties of the red fox, and this is the opinion of the native hunters. A rare variety is the black or silver fox, so valuable for its fur. Sir J. Richardson says that seldom more than four or five of this variety are taken in a season at one post. It is black, with the tips of the hairs silvered.

As a marked example of a section of the genus, the Arctic Fox (*Vulpes lagopus*) requires notice. This species is common to the regions of the Arctic circle in the Old and New Worlds. It is commonly known by the designation of blue fox, on account of its peculiar deep ashy, leaden, or bluish-coloured hair. The fur varies much in appearance at different periods of the year and according to the place of abode, being very commonly of a brownish-gray colour in some districts, and in others sooty or almost black. In the winter the fur usually becomes pure white or whitish-yellow; but this is not invariably the case, as the sooty



American Red Fox (*Vulpes fulvus*).

variety is said scarcely to alter its colour in any respect; its texture is woolly, the individual hairs being comparatively long. According to a recent authority, Dr. Robert Brown, there are really two varieties of this fox, which keep their distinctive colours throughout the year. The Arctic fox is considerably less than our European species, the tail being well developed and very bushy towards the tip. The ears are short and rounded. The soles of the feet are densely furred. The food of this species consists of eggs, blubber, carrion, and lemmings of different species. In its habits it is extremely cleanly. It is gregarious, forming burrows in sandy spots, twenty or thirty together. The Arctic fox displays far less cunning than our European species, and is not so suspicious of traps. Usually these foxes are captured by means of an elevated pitfall, which consists of a hut built up with stones, and arched over, leaving only an aperture at the summit, over which blades of whalebone are fixed in such a manner as to insure the certain precipitation of the fox into the interior, should the bait, also placed at the upper part, successfully allure him on to the top of the roof. In the young state, the flesh of the Arctic fox is stated to be excellent eating. The fur is employed as an article of commerce, many thousand skins being annually imported into Britain; the bluish variety is the most valuable.

FOX, CHARLES JAMES, born on the 24th of January, 1749, was the third son of the Right Hon. Henry Fox, who in 1763 was created Lord Holland.

From a preparatory school at Wandsworth, Fox was sent at the age of nine to Eton. His education was interrupted by a three months' trip to Paris and to Spa, in which he was accompanied by his father, to whose misplaced indulgence, it is said, during this tour, is to be traced the devotion to the gaming table which ever after was the principal alloy of Fox's happiness. In 1764 he entered at Hertford College, Oxford, and pursued learning and pleasure in turn. He left Oxford in 1766, went abroad, and having passed two years chiefly in Italy, returned to England in 1768. In his absence he had been elected member of Parliament for Midhurst, in Sussex.

Fox took his seat in Parliament as a supporter of the Duke of Grafton's ministry. In 1770, when the Duke of Grafton was succeeded by Lord North as prime minister, Fox was appointed junior lord of the admiralty. He resigned this situation two years after, in consequence of some misunderstanding with Lord North; but in less than twelve months he was brought back into the ministry as one of the lords of the treasury. In February of the next year he was dismissed, chiefly through the enmity of the king. Edmund Burke now began to have considerable influence over him.

It was on Lord North's Boston Port Bill, the measure that led to the American Revolution, that Fox first opposed that minister. He took his stand, first, on the principle that the American colonies ought not to be taxed without being represented; and secondly, on the inexpediency of endeavouring to wring taxes from them by force and at the risk of rebellion. In the beginning of 1780 Burke brought forward his plan of economical reform, which was zealously supported by Fox and by petitions pouring in from all parts of the kingdom for a reduction of the public expenditure. On the 6th of April resolutions were carried against the influence of the crown, and in favour of an inquiry into the expenditure of the country, and of a diminution thereof. On the 27th of February, 1782, a motion of General Conway's for the discontinuance of the war was carried by a majority of nineteen. On the 19th of March the ministers resigned. Fox now was the leading member of the Opposition, and exceedingly popular. At the general election in 1780 he had been returned for Westminster, in spite of every court effort and every trick of intrigue and intimidation. On the formation of the new ministry under Lord Rockingham, Fox was appointed secretary of state for foreign affairs. He instructed Mr. Grenville, plenipotentiary at Paris, to propose to the American agents there the independence of the United States of America, to which the king's assent had been obtained. But the ministry contained Lord Shelburne, who was believed by Fox to be doing his utmost to thwart the measures of the ministry for bringing about a peace. Fox resigned upon the death of Lord Rockingham, which took place only four months after the formation of the ministry, which was then broken up.

Peace or war with America no longer dividing Fox and Lord North, they united in Opposition, and formed the famous coalition. The new or Shelburne ministry were overthrown in February, 1783, and one under the Duke of Portland was formed, with Lord North and Fox as secretaries of state. Wanting in the support of the country, and strong in the Commons only through the influence of the Whig pocket members, it soon fell, under the combined influence of the king's dislike and the opposition of commercial men to an impracticable East India Bill introduced by Fox. A new ministry was formed almost immediately under Mr. Pitt.

The new ministers, notwithstanding the adverse majority, who sought to prevent a dissolution by unscrupulous measures, persevered, dissolved the House, and obtained the unmistakable support of the country. Fox re-entered the House as member for a Scottish borough. He had been elected for Westminster, but through the party and personal animosity of Pitt and his friends twelve months elapsed before his election was acknowledged. The question of Warren Hastings' Indian administration was brought forward by Burke, and in the discussion that followed Fox took a very active part. In 1788 the king's illness rendered necessary a regency; and while Pitt contended that it was for the two houses of Parliament to appoint the regent, Fox maintained that the regency belonged of right to the Prince of Wales. The king's speedy recovery rendered it unnecessary to bring the question to a decision.

In 1789 and later Fox distinguished himself by the

support of a motion for the repeal of the Test and Corporation Acts. On the dissolution of Parliament in 1790 he was again returned for Westminster. Differences of opinion on the French Revolution led in May, 1791, to a termination, not merely of his political alliance, but also of his friendship with Burke.

Fox then supported Wilberforce's motion for the abolition of the slave trade. From the latter part of 1792 to 1797 his efforts were unceasing, first, to prevent a war with France, and afterwards, when his warnings had been of no avail, and it had been entered into, to bring it to a close. We must mention also the support which in 1793 he gave to Mr. (afterwards Earl) Grey's famous motion for parliamentary reform; his indefatigable opposition to the treason and sedition bills of 1795; and his attempt to procure attention to the state of Ireland and to the grievances of the Irish Catholics. Poorly supported by his own party, and hopeless of effecting his purposes, at length in 1797 he announced his resolution to discontinue his attendance at the House. He occupied the five years of his retirement with literary pursuits. In 1802 he paid a visit to Paris, where he was treated with marked attention by Napoleon.

At length Pitt's cabinet was broken up by the question of Catholic emancipation, and Addington succeeded. He at once commenced negotiations for peace with France, which resulted in the peace of Amiens. Fox reappeared to express his joy. But war soon broke out again, and Addington resigned. Pitt and Fox would now together have formed a ministry, but the king was unchangeably hostile to the latter, and Pitt did the best he could with the wreck of the Addington ministry. On the 23rd of January, 1806, Pitt's death dissolved the ministry; and in the new one which was formed under Lord Grenville, Fox was appointed secretary for foreign affairs; but he was obliged by the ambition of France to adhere to a vigorous war policy. His life was spared only for seven months longer. He died on the 13th September, 1806, in the fifty-eighth year of his age, of water on the chest.

Though Fox was not, in the full and strict sense of the term, a philosophic statesman, he came nearer to it perhaps than any other English statesman, not even excepting Burke. Sir James Mackintosh has said of him as an orator, "that he was the most Demosthenean speaker since the days of Demosthenes." Fox's speeches were published in six volumes in 1825. The fragment which he left of his projected history of the reign of James II. was published in 1808, with a preface by Lord Holland.

FOX, GEORGE, founder of the religious body termed the Society of Friends, was born at Drayton, in Leicestershire, in July, 1624. His parents were religious people, and from his childhood his character was marked by seriousness and earnestness. When old enough he was apprenticed to a shoemaker, who also carried on a trade in wool and cattle. In this employment he remained until his nineteenth year, and seems to have earned general esteem by his uprightness. As he grew older his mind became more and more concentrated on the intense reality of religion. Having consulted many clergymen, and gained no benefit from their advice and guidance, he went to an uncle in London, a Baptist of considerable importance, who received him kindly. But George discovered that this uncle was, like the rest, "in darkness;" and, fearing that his parents would be getting very anxious about him, he retraced his steps to Drayton. He appears to have remained at home for about twelve months. The parson of the parish—a bookworm—tried to get him out of his religious difficulties, but made no progress. Various persons—parsons, doctors, and others—tried to help him. He was evidently walking in a path in which none of them—some of them being light and frivolous—could accompany him. He wandered from place to place "seeking rest and finding none." At length he felt himself called upon to preach, and in the opinion of Carlyle (see "Sartor Resartus"), "No grander thing was ever done than when George Fox, stitching himself a suit of leather, went forth determined to find truth for himself, and to do battle for it against all superstition, bigotry, and intolerance."

The central idea of Fox's teaching was that men should listen and subject themselves to the light of Christ as a real active light shining through the darkness of existence, which God had planted in the heart of every man. Though his narrow education, and the circumstances attending his early mode of life, led him into many extravagances, such as living in the hollow of a tree in the woods; separating himself from his friends and relations from a self-wrapt notion that the company of neither old nor young could profit him; repudiating ordinary salutations and modes of address, and interfering with the modes of worship of other religious bodies that differed from his own only in the nature of their customs, not in the importance in which they held them—it cannot be denied that his aim was pure and noble, and that he was no charlatan lying for his own advantage, but the worthy founder of a sect that has had an immense influence for good in many parts of the world. Unfortunately, in the unsettled times in which Fox lived, the peculiarities and less worthy portion of his practice were precisely such as to fix the ridicule and rouse the dislike of men still smarting under the memory of the rule of Puritan intolerance. They were also such as were most likely to endanger the public peace, and in consequence the leader and his followers were involved in much persecution and distress. From 1648 till within a few years of his death his life was made up of travel, disputation, and imprisonment. He visited the Continent several times, our American colonies in 1671, and the Netherlands in 1677 and 1681. He died in London in 1691. He had, as we have seen, an eventful career, and came into contact with many kinds and classes of people. His intercourse with Cromwell is remembered by every student of the period. He was a troublesome and unmanageable foe, and most of his persecutors found it advisable or necessary to act with caution and sagacity in dealing with him. He outlived the storms, and saw what he felt to be a good work prospering in the nation. Undoubtedly he rendered a brave testimony, and left an important example for his countrymen to study and, in highest senses, to emulate.

The new faith cut athwart nearly all vested interests. The dogma of an unpaid ministry was hateful to the ministers of other denominations; its nonlitigious principles dealt as great a blow at the very existence of the lawyer as its noncombatant ones did at that of the soldier. All who loved the beautiful disliked the idea of a religion which forbade music and painting, and which prescribed a sober monotony of dress. While the gay dreaded one that held every amusement, however harmless, as mere waste of time, and therefore sinful, the rich and noble still more dreaded one that destroyed all inequalities of rank, and forbade the homage they considered theirs by right.

The Friends' system ran perpetually counter to the habits and customs of the time. Other dissenters, if they chose, might conform to them in social or political matters, but the Quaker (a name originally given in derision) was forbidden by his creed to do so. In the house and workshop, in the fields or on the highway, he was a marked man. His speech was couched in different phrases from that of other men; his dress was not of the same cut, and was of more sober colour; his manners were less polished and seemingly less courteous. His whole existence was a protest against conventionalities, nor could he consent to make any concessions to the weaker brethren.

The story of Fox's life is told in an exceedingly interesting

manner in "George Fox and the Early Quakers." by A. C. Bickley (London, 1884). See also the article, FRIENDS, SOCIETY OF.

FOX, WILLIAM JOHNSON, an eminent Unitarian minister and a member of Parliament, was son of Mr. Paul Fox, a farmer and yeoman of Wrentham, Suffolk. He was born in Suffolk in 1786, and was educated at Homerton, near London, for the ministry of the Independent body. On arriving at manhood, however, he adopted Unitarian opinions, and was for some time one of the most able and popular ministers of that body. Ultimately, however, he shook off allegiance to all existing churches, and his admirers built him a chapel at South Place, Finsbury, in which for many years he delivered such discourses as marked him out as the leader of English rationalism. In addition to his religious lectures, he entered heart and soul into the field of politics, contributed largely to Liberal newspapers and reviews during the agitation for the repeal of the corn laws, became a salaried lecturer for the league, and obtained great popularity among the working classes. Among other papers to which he contributed was the *League*, in which he wrote some remarkable papers, signed "The Norwich Weaver Boy." He was also for many years a contributor to the *Westminster* and other reviews. In 1847 he entered Parliament as member for Oldham, which he represented almost uninterruptedly till his death, 3rd June, 1864. His works were collected and published in twelve volumes in 1865.

FOX ISLANDS. See ALEUTIAN ISLANDS.

FOXE, JOHN, commonly called the *Martyrologist*, was born at Boston, in Lincolnshire, in 1517. He was entered at Brasenose College, Oxford, in 1531, and elected a fellow of Magdalen College in 1543. Having applied himself with great earnestness to the study of divinity, he became a convert to Protestantism, and was deprived of his fellowship for heresy in 1545. After suffering many hardships owing to his religious opinions he was taken into the house of Mary, duchess of Richmond, to instruct the children of her brother, the unfortunate Earl of Surrey. After the accession of Edward VI. Foxe was appointed to another fellowship, but he was an exile in the time of Mary. On his return to England his former pupil, now Duke of Norfolk, settled a pension on him for life. A prebend in the church of Canterbury was also given to him by Cecil. He never would subscribe to the articles of religion as finally settled, and this prevented his attaining any higher dignity in the church.

Foxe died in 1587. He was the author of numerous works, but the only one that is now remembered is his "Book of Martyrs," of which a small part was first printed at Strasburg in 1554; the complete work was first published in England in 1563. Whatever mistakes may have crept into this book, the honesty of the author remains unimpeached.

FOX'GLOVE (Digitalis), a genus of plants belonging to the order SCROPHULARINEÆ. Several species are known. *Digitalis lutea* is a common plant in the woods of France and Germany. *Digitalis grandiflora* is met with rather more to the eastward; while *Digitalis ferruginea* and its allies, with short roundish rust-coloured flowers, occur not unfrequently in the south-eastern parts of Europe and in Asia.

Over all the west of Europe, but not in Asia, is found abundantly, especially in England and France, the Common Foxglove (*Digitalis purpurea*), a very handsome species, with large purple or sometimes white flowers. It is employed in medicine. The most useful leaves are those procured from plants growing on the sunny sides of hills. They must be carefully dried and protected from damp. The active principle resides in an extractive substance, which by careful evaporation may be crystallized, and to which the name of Digitalin has been given. This principle is soluble in water and in alcohol. It is very poisonous. Digitalis is given in powder, in pills, or in an alcoholic tincture. When but a small quantity at rapid intervals is given the effect is at first stimulant, but when a large dose is administered the sedative action commences immediately.

Digitalis is the most perfect example known of accumulative poison, as it may be used for some time, if the doses be small, without producing any manifest effect for several days, when sudden faintness, intermittent pulse, giddiness, and other alarming symptoms appear. These are best combated by vital stimulants, such as warm brandy and water.

Digitalis has the power of reducing, in a remarkable degree, the heart's action, bringing down the pulse from 120 or more to 50 or 40 beats in a minute, and causing it to become at the same time intermittent. On this power depends its medicinal value in some diseases.

As a diuretic, it is, like most medicines of that class, uncertain in its effects; it seldom answers if much inflammatory action exists when it is administered. To render it more certain it is generally given along with calomel and squills, or some other diuretic.

FOX'HOUND is a dog used in England for the favourite sport of FOX-HUNTING. This is the most important of the hounds, and the one in which there has been attained "the highest possible degree of excellence in the union of fine scent, fleetness, strength, perseverance, and temper" (Bell). The foxhound is a cross between the old English hound and the greyhound. It stands about 20 or 22 inches high at the shoulder. The fur is short and is usually white in colour, with large patches of black and tan, but the colour varies greatly. The ears are long and drooping, the tail fairly straight. The pace and endurance of the foxhound are very remarkable. A run of 4 miles in seven minutes is recorded of one of these hounds.

FOX-HUNTING. This sport is one of the most popular amusements of the higher classes in Great Britain, where there are upwards of 100 hunting establishments, of which the greater portion are in England. These are maintained at great cost, either by private gentlemen of wealth, or more generally by subscription. The hound used for the sport is not so large as the staghound, and is of a mixed breed between the bloodhound and the greyhound. The colour is usually white, with large patches of black and tan. They are remarkable for speed and perseverance, and have been known to run hard for ten hours before they came up with and killed the fox, and the sportsmen have had to change horses three times during a run. A *pack* is composed of from twenty to sixty couples of hounds. The establishment is conducted by a master, huntsman, whippers-in, and servants. The huntsman is the most important of these, and has to see that the dogs receive fair play in the field, and find and hunt the fox in the best style. He must be a first-rate rider, and well acquainted with the country over which he hunts. He, in fact, provides the sport, and conducts it from beginning to end. The head whipper-in is a sort of assistant huntsman. As we have before stated [see FOX], the fox inhabits burrows, and is a nocturnal feeder. Advantage is taken of this to stop up all his holes the night previous to the hunt, when the fox, finding that he cannot hide in his usual manner, goes to a thicket or cover of gorse and makes a temporary lair. After the hunt the burrows are reopened. The time of meeting is usually ten or eleven o'clock a.m., and is often a brilliant spectacle, frequently attended by ladies who come to see the hounds "throw off." The huntsman and some of the dogs enter the nearest covert and drive the fox out. This being done, the cry of "Tally-ho!" "Gone away!" is raised, and the huntsman collects his hounds, and then he and the entire field join in the chase. It does not matter that the fox gets out of

sight, as the dogs hunt almost entirely by scent. When the scent becomes faint or lost entirely—as it does when the fox crosses water, runs through a flock of sheep, or along a wall—the huntsman blows his horn, and leading the dogs round and about, tries to recover the scent; and if successful, the chase continues, but if not the hounds are taken to another covert and a fresh fox drawn. When a fox is killed the huntsman springs off his horse, and lashing the dogs off, cuts off the head, feet, and tail, giving the carcase back to the hounds to devour. The tail, or brush, is presented to any lady who may happen to be in at the death, or to the gentleman rider who is first at the scene; but instances are not wanting in which the hounds have left every rider far behind, and have killed their fox miles from the spot where the last horseman gave in. The feet or pads are also distributed to those present. The midland counties of England are considered the best for fox-hunting, owing to the extensive tracts of pasturage and numerous coverts, but almost every county has one or more packs of hounds kept in it.

FOX-SHARK or **THRESHER** (*Alopecias vulpes*) is a species of SHARK seen somewhat frequently on British coasts. It is common in the Atlantic and Mediterranean, as well as on the coasts of California and New Zealand. The two common names refer to the size of the caudal fin, the upper lobe of which is enormously developed, being equal in length to the rest of the body. It feeds on herrings, sprats, and pilchards, following the shoals, splashing the surface of the water with its long tail, and swimming in gradually decreasing circles round its victims, which are thus kept crowded together and fall an easy prey to their voracious enemy. The fox-shark is said to attack whales and dolphins with blows of its tail, and several instances are recorded of attacks in concert by sword-fishes and fox-sharks on whales. It attains a length of 15 feet.

The fox-shark is the only species in the genus Alopecias. In this genus the nictitating membranes are wanting. The first dorsal fin is opposite to the space between the pectoral and ventral fins. The second dorsal and anal are very small. The upper lobe of the caudal fin is enormously developed. The snout is short and conical. Spiracles are minute. The teeth are alike in both jaws, lancet-shaped, and triangular.

FOXTAIL GRASS (Alopecurus), a genus of GRASSES. The common Meadow Foxtail Grass (*Alopecurus pratensis*) is well known. Its stem is erect, panicle spiked, glumes acute, and awn projecting about half the length of the floret. It is a very nutritive grass, and is therefore generally sown in pastures. It grows well on limestone soils.

FOYLE and **LOUGH FOYLE.** See DONEGAL, LONDONDERRY.

FRA ANGEL'ICO. See ANGELICO, FRA.

FRA BARTOLOMME'O. See BACCIO DELLA PORTA.

FRA DIA'VOLO, the *nom de guerre* of an Italian brigand named Michele Pezza, of some considerable notoriety at the close of the last century and the beginning of this. He was a monk originally, whence his name of Fra Diavolo (the Devil-friar), but escaped from the cloister and assembled a band of ruffians, with whom he lived in the caves of the Apennines in Calabria, levying blackmail on all who came within his reach. Auber's opera, of course, poetizes the ruffian, converting him from a social pest into a hero of romance. Fra Diavolo was captured and executed by the French in 1806, being then probably nearly fifty years old. He had taken service with the Neapolitans on the invasion of the French, and had thus gained his pardon, and even the rank of colonel, from the King of Naples. He was executed, not for his crimes, as he richly deserved to be, but for his patriotism, somewhat undeservedly. His papers appeared genuine to the English admiral, Sir Sidney Smith, but the French refused to believe them, and therefore denied him the rights of a belligerent.

FRACTIONS (Lat. *fractio*, a part broken off). By a fraction is meant, in the first instance, a part of any magnitude. Thus, "three and a fraction" means three units and a part of a fourth unit. The next meaning of the term confines fractions, in an arithmetical point of view, to the *aliquot* parts or *submultiples* of the unit, which unit must therefore be divided into a number of equal parts, of which parts a certain number is to be taken.

A fraction is thus denoted: $\frac{a}{b}$ means the quantity obtained by dividing a unit into b equal parts and taking a of those parts. If a be greater than b, it will obviously be necessary to divide more units than one, each into b equal parts, until enough have been subdivided to furnish the a parts required. It is usual, in English works on arithmetic, to call fractions in which a is less than b *proper* fractions, and all others *improper* fractions. In the preceding fraction a is called the *numerator* and b the *denominator.*

The fundamental property of fractions, on which all others depend, is this—that no fraction is changed in value by multiplying or dividing both its terms by the same number or fraction, that is—

$$\frac{a}{b} = \frac{ma}{mb}$$

whatever may be the values of a, b, and m.

In practice it is inconvenient to employ fractions having either the same denominators, or which may easily be reduced to others of equal value having the same denominators. The numbers 10, 100, 1000, &c., suggest themselves for this purpose; indeed it may be immediately seen that the ordinary system of decimal numeration may be extended so as to allow of a representation of such fractions. If we consider the number 11111, we see that for every step which we take to the right, we find a unit which is only the tenth part of the preceding unit. Place a point at the unit's place (to mark its position), and let the same method of valuation be carried further to the right. Then in 11111·1111, the first one after the point should stand for one-tenth of the preceding, or one-tenth of a unit; the second for one-tenth of a tenth, or one-hundredth, and so on. The fundamental theorem of decimal fractions, in this view of the subject, is that which shows, for example, that 12·2345 (defined to mean 1 ten, 2 units, 2 tenths, 3 hundredths, 4 thousandths, and 5 ten-thousandths) is the same as 122345 ten-thousandths; or that all the number, such as it would be if the units column were on the right, may be taken as a numerator, and the denomination of the right-hand figure as a denominator. Thus—

$$65{\cdot}483 \text{ or } 60 + 5 + \frac{4}{10} + \frac{8}{100} + \frac{3}{1000}$$

$$\text{is } \frac{60000}{1000} + \frac{5000}{1000} + \frac{400}{1000} + \frac{80}{1000} + \frac{3}{1000} \text{ or } \frac{65483}{1000}.$$

It is common to say that a result is true to a certain number of places of decimals when any alteration of any place would make it further from the truth. Thus, the diameter of a circle being unity, the circumference lies between 3·1415 and 3·1416, but nearer to the latter; whence the same circumference, true to four places of decimals, is 3·1416. Similarly 62·13291, taken true to two places, is 62·13; to three, 62·133; to four, 62·1329. Again. ·625, taken true to two places, might be either ·62 or ·63; but the latter is generally taken. The two kinds of fractions, that just described and the ordinary or vulgar fractions, are further described in detail in the articles DECIMAL FRACTIONS and VULGAR FRACTIONS respectively.

For subjects closely connected with the theory of fractions, see RATIO, PROPORTION, INCOMMENSURABLE.

FRACTIONS, CONTINUED. A continued fraction is one which has a fraction in its denominator, which again has a fraction in *its* denominator, and so on; such as

$$\cfrac{1}{2+\cfrac{3}{7+\cfrac{6}{1+\cfrac{2}{3}}}}$$

This of course is worked out from below. $1 + \frac{2}{3} = \frac{5}{3}$. If 6 be divided by this, we get $6 \div \frac{5}{3} = \frac{18}{5}$ and $7 + \frac{18}{5} = \frac{53}{5}$. Next, $3 \div \frac{53}{5} = \frac{15}{53}$ and $2 + \frac{15}{53} = \frac{121}{53}$. Finally, $1 \div \frac{121}{53} = \frac{53}{121}$.

FRACTIONS, VANISHING. This term is applied to fractions in cases where a supposition is made which destroys both numerator and denominator at the same time. Thus—

$$\left(\frac{x^2-1}{x-1}\right) \quad \frac{\log. x}{x-1}, \quad \frac{a^x-a}{b^x-b},$$

are fractions which all assume the form $\frac{0}{0}$ when $x = 1$: that is, though for any other value of x they represent operations of ordinary arithmetic, yet in the particular supposition that x is unity, they all end in a direction to find out how many times nothing is contained in nothing. The method of the mathematician is to substitute for the vanishing fraction the value to which it approaches as the numerator and denominator diminish.

FRACTURE. Injuries complicated with the breaking of a bone are called *fractures*. The comparative importance of such accidents depends, in the first place, upon that of the bone which is broken. The most dangerous fractures in this point of view are those of the vertebræ and skull, which inclose organs immediately essential to life and extremely susceptible of injury.

Fractures are said to be *transverse* or *oblique*, a distinction of great practical importance. In the first or *transverse* variety, the bluntness of the ends of the broken bone in some measure preserves the contiguous soft parts from laceration at the time of the accident; it also opposes a considerable obstacle to the displacement which arises afterwards from muscular contraction; but it chiefly conduces both to the diminution of present suffering and to the prosperous event of the case, by facilitating the speedy and perfect restoration of the displaced bone to its proper situation, and its steady retention, when restored, by mechanical means.

On the other hand, as most of the bones liable to fracture are cylindrical, or present flattened surfaces meeting in as many solid angles, if they be broken obliquely, the ends of the bone will be sharp-edged or pointed; hence they are generally separated from each other to a much greater extent than is usual in transverse fractures, and there is not only much more suffering from the laceration of sensitive parts and from portions of them being included and pressed between the broken surfaces, but great difficulty is often experienced in disentangling the ends of the bones, and bringing them into close apposition; and still more in retaining them, from their tendency to slip past each other during the spasmodic and powerful contractions of the wounded and irritated muscles. The result of such fractures is often unsatisfactory, in spite of the utmost care and skill; and some distortion and shortening of the limb is inevitable in severe cases.

Surgeons distinguish several other kinds of fracture. When a bone is crushed, or fissured in more than one direction, so that portions of it are detached from the rest, the fracture is said to be *comminuted*. From the facility generally experienced in replacing the bone, or at least in straightening and supporting the limb in these cases, they often end better than apparently less serious oblique fractures.

A bone may of course be broken in the situation of a joint; or, if the fracture occur at some distance, a fissure may extend longitudinally into one of these cavities. This circumstance is a very important aggravation of the injury. The synovial membranes which line the joints are peculiarly impatient of irritation, and when they become inflamed, the constitutional disturbance is often considerable, and the attendant or, as it is called, the *symptomatic* fever, is of a very acute type.

Fracture is sometimes complicated with dislocation. If a bone be dislocated as well as broken, it may be difficult or impossible to carry into effect the measures which are necessary for the satisfactory treatment of either injury, and the result is permanent distortion and crippling of the limb.

If the injury of which we are treating be confined to the bones and the parts immediately around them, the fracture is said to be *simple;* but if the bone be protruded through the skin, or an external wound otherwise inflicted communicate with the interval between the broken surfaces, the fracture is said to be *compound.* This is a much more serious circumstance than might at first sight have been supposed. It is often followed by most severe inflammation, and death is not unfrequently the consequence.

In fracture the nature of the accident is generally obvious enough; but where there is any doubt, it may be removed by attending to the grating sound, or the sensation communicated to the touch occasioned by slightly moving the broken ends of the bone against each other. This symptom is called *crepitation.*

The principles of treatment are, in the first place, to guard against all rough manipulation of the injured part lest a simple fracture be rendered compound, and to soothe by all possible and prudent means the muscular irritation and spasm which are the immediate and most urgent consequences of a recent fracture.

When the relaxing rigidity of the muscles will permit, which may not be for some hours or days, the bone is to be restored as nearly as possible to its proper situation by the gentle application of force in any required direction.

When the limb is reduced it should be placed in *splints,* which are thin pieces of wood or other material of the requisite firmness and length, and suitably shaped and hollowed out to fit evenly without making undue pressure upon prominent points, such as the ankle. The skin is to be protected by folds of linen, or thin soft pads a little wider than the splints, which are also useful to prevent them from slipping. When everything is properly arranged as to position, the splints should be bound upon the limb with a moderate degree of pressure; and it is right to remove and readjust them occasionally, in order to detect and rectify any deviation from the correct line of the bone that may arise or become apparent as the swelling subsides.

In fracture of the ribs it is sufficient to apply a broad belt or bandage to prevent them from alternate depression and elevation in the act of breathing, which can be carried on sufficiently well by the diaphragm alone.

It will be evident that the treatment of broken bones requires skilled professional attention, but when an accident involving fracture has happened, much may be done by an intelligent bystander to prevent further mischief. A broken arm may be bound round with a handkerchief, a piece of common cardboard being placed on either side, and the limb supported by another handkerchief slung round the neck. In the case of a broken leg temporary splints may be made by using walking sticks or umbrellas, or a handful or two of stiff clean wheaten straw, and these if bound carefully to the limb with a few handkerchiefs before the patient is moved may be of great service in preventing pain and further injury. A man having a broken leg should always be carried in a horizontal position where possible, and where a proper litter or stretcher cannot be obtained a hurdle or small door taken off its

hinges and provided with a mattress and pillow will make a very good substitute.

Union of Fractured Bones.—The process by which fractured bones are united is generally uninterrupted in simple cases, if the constitution be good and the accompanying contusion not very considerable. The extravasated blood is soon absorbed, and the swelling and inflammation subside. The interior lacerations heal, and the soft parts round the ends of the fracture become consolidated with the periosteum or fibrous investment of the bone, which swells and unites at the torn edge. In this consolidated mass, which forms a soft case for the bone for some distance above and below the fracture, but is thickest just at that point, particles and spicula of bone are gradually deposited, till at length it becomes rigid and firm, holding the ends of the bone in close contact, and preventing them from slipping away from each other, like the slider of a parasol. At length the patient finds the strength of his limb restored, and, conscious of the change, can no longer be persuaded to refrain from using it. After a certain period, which has been differently stated—perhaps six or seven months in the case of a large bone—the fractured ends become firmly adherent by the deposit of bony matter between them, the exterior case becomes absorbed, and the cure is complete, the bone being rather thicker and generally somewhat stronger and more solid in the situation of the fracture than before the accident. The whole of this process is much quicker in infants and children than in adults, and somewhat more slow in advanced periods of life than in the middle age, the bones of old people being more brittle from the excess of earthy materials. Taking all ages, it ranges from two to eight or ten weeks—speaking, of course, of the period at which the limb becomes firm enough to perform its functions.

FRACTURE. Many minerals and rocks break in a characteristic way, which is spoken of as their fracture. The direction of breaking must, however, be different to a cleavage plane. [See CLEAVAGE.] Fractures are spoken of as—(1), *conchoidal*, when smooth and concave (or convex): glass, calcite, and quartz have a fracture of this description; (2), *smooth*, like opal; (3), *splintery*, like pitchstone and magnetite; (4), *hackly* (covered with fine points), like that of native copper and silver; (5), *earthy*, like bole and fuller's earth. Rocks may also have *foliated*, *slaty*, or *shaly* fracture; gneiss, roofing-slate, and bituminous shales are, respectively, instances of these forms of fracture.

FRAISE is a row of palisades placed in a horizontal or inclined position on the exterior of a rampart of earth, in order to increase the difficulty of passing over it at the time of the assault.

FRAM'LINGHAM, or "Strangers' Town," a market-town of England, in the county of Suffolk, 14 miles N.N.E. from Ipswich, and 90 miles from London by the Great Eastern Railway, is situated near the head of the river Ore, which, a little to the north, expands into an extensive pond or mere. The streets are irregularly laid out, but there are many well-built houses and a spacious market-place. The chief buildings are the Albert Memorial Middle Class College, which has accommodation for 300 pupils, and in which a good education is imparted; a new corn-exchange, and a people's hall. There is a statue of the Prince Consort opposite the college. The church is built, like most of the Suffolk churches, of flint and stone, with a tower 96 feet high, containing a peal of eight bells. Here are the monuments of Thomas Howard, third duke of Norfolk, and of his duchess; and of the unfortunate Earl of Surrey, beheaded by Henry VIII., and his countess. The town also contains a free school and many almshouses. Framlingham Castle, the seat of the Howards, is in ruins, but the exterior wall, 44 feet high and 8 feet thick, remains, and there are thirteen square towers, each about 58 feet high. The castle is said to have been founded by Redwald, king of East Anglia. The principal gateway is embellished with the shields of the various lords who have possessed the castle. Here Queen Mary retired during the attempt to place Lady Jane Grey on the throne, after the death of Edward VI. The population of the town in 1881 was 2518.

FRANC, the monetary unit in France since 1795, in Belgium since 1833, and in Switzerland since 1849. It is a silver coin, weighs 5 grammes, and is worth nominally about $9\frac{1}{2}d$. It is divided into 100 centimes or 20 sous. Of silver coins there are in France $\frac{1}{4}$, $\frac{1}{2}$, 1, 2, and 5 francs; and gold pieces of 5, 10, 20, 40, and 100 francs. Italy has accepted an equivalent coinage, but the coin of the same value as the franc is called in Italian *lira*. The single franc is not worth its nominal value. Whereas the five-franc piece is of ·900 fineness, the single franc is of only ·835; so that instead of being worth $9\frac{1}{2}d$. it is actually only worth as metal a little over $8\frac{2}{3}d$. The standard for gold being also ·900, and the English standard being ·916⅔, the twenty-franc gold piece may be compared with the sovereign. It is then found that the intrinsic value of the sovereign is 25·22 (nearly $25\frac{1}{4}$) francs. The theoretical value of one franc is thus 9·516 pence (over $9\frac{1}{2}d$.)

FRANCE, the most westerly of the kingdoms of continental Europe, with the exception of the Spanish peninsula. Its form is very compact, being nearly square. It is comprehended between 42° 20′ and 51° 5′ N. lat., and 7° 40′ E. lon. and 4° 43′ W. lon. The greatest length from S.E. to N.W. is about 680 miles, and the greatest breadth N.E. to S.W. about 580 miles. The area is 204,177 English square miles.

Coast, Islands, and Frontier.—The N.N.W. coast, which lies opposite to England, extends about 480 miles, and is irregular in its outline, being indented by several bays, that of St. Malo being the principal. It is generally of a rocky nature. The remainder of the coast faces the south-west and west, and extends about 450 miles; the northern half is for the most part rocky, but the southern half, bounded by the Bay of Biscay, is generally low and sandy. The Mediterranean coast extends for about 300 miles, and forms the two bays of Lyons and Genoa, separated by the coast about Toulon. Eastward of Toulon it is more generally rugged than westward of the same point. The latter part has many small inlets.

Along the coast are several islands. In La Manche (the English Channel) are Guernsey, Jersey, Alderney, and Sark, which belong to the English crown; the islands of Brehant, the Sept Iles (the Seven Islands), and the Isle of Bas. At the western extremity of France are the isles of Ouessant (Ushant), and along the remainder of the coast are the isles of Glenan, Groaix, Belle-Ile, Noirmoutier, Ile-Dieu, Ré, Oléron, and others of less importance. In the Mediterranean are Hyères and Corse or Corsica.

The land frontier of France is, for the most part, formed by great natural barriers. On the southern or Spanish frontier are the Pyrenees. On the south-east the frontier is formed by the Alps and the Jura towards Italy and Switzerland. On the east the river Moselle and the Vosges Mountains separate France from Germany. The remaining part of the frontier borders on Belgium. The land frontier, from Nice to Dunkirk, measures about 720 miles.

Mountains and Rivers.—The loftiest mountains in France are those on the Italian and Spanish frontiers, the Alps and Pyrenees. The highest of the French Pyrenees is Vignemale, 11,000 feet. The French portion of the Alps now includes the highest mountains and most elevated passes of the range—such as Mont Blanc, in the department of Haute Savoie, 15,781 feet; Mont Iseran, 13,272 feet; the Pass of Little St. Bernard, 7190 feet; and that of Mont Cenis, 6770 feet above the level of the sea. The Cévennes are separated from the Pyrenees by a wide valley,

through which the great canal of Languedoc runs. Mont Mezen, the highest of the Cévennes, is 5820 feet high, and Mont Gerbier de Jones, at the source of the Loire, 5125. The mountains of Auvergne rather surpass these in height. The Côte d'Or of Burgundy connects the Cévennes with the Vosges, whose branches extend to the south-east so as to unite with the Jura, and whose wild and wooded steeps now form the boundary between France and Germany. A range of heights extends N.W. from about Langres to Cape Gris-Nez, separating the streams which belong to the great system of the Rhine from those which belong to the river systems of Central France. Various minor ranges separate from each other the basins of the Seine, the Somme, the Loire, the Garonne, and the Adour.

The mountains and ridges run in such directions as to separate France into three great slopes, the western, the north-eastern, and the south-eastern. The western slope includes the basins of the Adour, the Garonne, the Charente, the Loire, the Vilaine, the Orne, the Seine, the Somme, and a number of others of less importance. The north-eastern slope comprehends part of the basins of the Escaut or Scheldt, and the Meuse or Maes, but only a comparatively small part of the course of each of these rivers belongs to France. The south-eastern or Mediterranean slope comprehends the basin of the Rhône, and of one or two other streams which are too small to require notice. The following are about the lengths of the chief rivers of France:—

	Miles.		Miles.
Loire, ...	600	Durance, . . .	220
Rhône, ...	525	Cher, ...	215
Seine, ...	470	Vienne, ...	207
Garonne, . . .	360	Tarn, ...	207
Saône, ...	304	Adour, ...	194
Dordogne, . . .	293	Isère, ...	190
Marne, ...	268	Creuse, ...	166
Doubs, ...	250	Lot, ...	166
Allier, ...	250	Vilaine, ...	124
Charente, . . .	235	Somme, ...	110

Geology and Climate.—The strata above the chalk occupy many extensive districts in France. One comprises the chief part of the basins of the Adour, Garonne, Lot, Dordógne, Tarn, Ariège, and other rivers in the S.W. part of the country. A second district is what is designated the Paris basin, extending for several miles in every direction round that city. A third district occupies portions of the basins of the Saône, the Rhône, and the Doubs; while other districts are found in the alluvial formation of the delta of the Rhône, and along many of the smaller valleys of France.

The chalk formation skirts the district occupied by the supercretaceous group on the north-east side alone. The Paris basin is surrounded on almost every side by the chalk, which forms a circular belt of widely varying breadth, from 24 to 100 miles; and the same formation occupies the coast of the channel from Cape Gris-Nez to the west of the mouth of the Seine, opposite to that of the south-east of England (Kent and Sussex). Experimental sinkings, near both Dover and Calais, to test the practicability of a Channel tunnel, show that in every probability chalk dips considerably beneath, and forms the bed of the Channel. There is certainly a remarkable geological coincidence between the Kentish coast and that of our nearest continental neighbour.

The new red sandstone and the magnesian limestone occupy only a small portion of France. The granites, slates, and other primitive rocks occupy several extensive districts—namely, the whole of Bretagne and the adjacent part of Normandy, and the other conterminous provinces in the west; the mountain district of Auvergne, part of the Cévennes, the hills of Vivarais, Forez, and the Charollais, and a large extent of country west of Auvergne; the Alps; the Pyrenees, in which calcareous formations abound, and organic remains are found at a vast height; a considerable insulated district in the southern part of the Cévennes, and a small tract in the northern part of France, between the Sambre and the Meuse. The volcanic region of Auvergne is described under AUVERGNE, GEOLOGY OF.

The climate of France is one of the finest in Europe, although, owing to its great extent, considerable diversities are to be met with. The northern parts have a continental and the north-western an oceanic climate, resembling those of Germany and Great Britain, while the Mediterranean districts are sometimes visited by burning winds from Africa and the north-west wind known as the *mistral*, both of which are very injurious. Less rain falls in the northern and western departments than in the southern and eastern. The mean annual temperature is from 50° to 62° Fahr.

Population.—The following table gives the area and population of France at the enumerations of May, 1866, of May, 1872, of Dec. 31, 1876, and Dec. 18, 1881:—

Census dates.	Area: Eng. sq. miles.	Population.	Average Population per sq. mile.
May, 1866, . . .	209,580	38,067,064	181
May, 1872, . . .	204,177	36,102,921	176
December 31, 1876,	204,177	36,905,788	180
December 18, 1881,	204,177	37,672,048	184

The decrease in area and population between 1866 and 1872 was due to the cessions made to Germany by the treaty of peace concluded 10th May, 1871. By its terms France lost one entire department, that of the Bas Rhin; two arrondissements, with fractions of a third, of the adjoining department of the Haut Rhin; and the greater portion of the department of the Moselle. The increase of population between 1872 and 1876 was ascribed in part to immigration from the provinces ceded to Germany. Between 1872 and 1876 there was an increase in the population of 802,867, or 2·2 per cent. in four years, equal to ·5 per cent. per annum. Between 1876 and 1881 the increase was 766,260, or 2·1 per cent. in five years, equal to ·42 per cent. per annum. The population, on the 18th of December 1881, was composed of 18,656,518 males and 18,748,772 females, the excess of females over males being less than in any other state of western Europe. The increase of population between the two census periods 1876 and 1881, amounting to 766,260, did not extend over all the departments of France. In thirty-four departments there was a decline of population (as compared with twenty between the two previous censuses), the greatest being in Orne, which had 16,400 inhabitants less at the end of 1881 than in May, 1876.

The increase of population in France within the last century and a half has been comparatively less than in any other state of western Europe. The natural increase, from the surplus of births over deaths, amounted, when at its highest, between the years 1820 and 1880, to not quite 280,000 per annum, and during part of the decennial period 1850 and 1860 sank to 51,200 per annum. There was a slight recovery during the first half of the next decennial period, but in the year 1869 the surplus of births over deaths had again fallen to 84,206. In the following two years, 1870 and 1871, the deaths exceeded the births, the excess of deaths amounting to 103,394 in 1870, and to 444,889 in 1871, due chiefly of course to the war. The birth-rate is about 2·75 per annum, or lower than that of any other country in Europe. Over the greater part of France the standard of comfort and well-being has been increasing ever since the termination of the

great war in 1815. The country had been so drained and impoverished by the wars of Napoleon and by a century and a half of bad government that the general misery of the population was indescribable, and the poverty even of the landed proprietors and middle classes was very great. The roads were bad and infested with brigands. The produce of the country found no markets for want of carriage, and killing a sheep in a country village was a rare event. Those were the days of extreme thrift at home and abroad. The habits of thrift have not been forgotten, although they have changed in kind, while the change of the condition of the country from one of poverty to extreme wealth is almost unparalleled in history. The creation of a railway system all over the country has raised the value of land enormously, and the produce of any part of the soil finds ever ready markets in the great centres of population and industry. The soil of France, above all, is one of the finest in the world, and its vineyards are really greater and more unfailing sources of wealth than mines of gold and silver, since their wealth, if they escape the ravages of the phylloxera, is virtually inexhaustible.

For many years, therefore, comfort and well-being, and even luxury, have made their way into the households of all classes in France. The standard of living has risen enormously. The habits of saving and thrift have not been neglected. In the art of managing and regularizing their lives French people are unrivalled, and the object of every family is to live and to save at the same time, so as to be able to leave their sons and daughters in as good a position as themselves at all events, and in a better, if possible. How inimical these aims in life are to anything like adventure and enterprise is only too apparent in the lives of all ordinary Frenchmen of the present day. Two professions —the army and the church—suffer immensely from this state of things, for, as a rule, no young Frenchman who can see his way to anything better will choose either career, a military one especially being regarded with increasing dislike.

Among people with such habits and such views of life, the risk and expenditure attendant upon a large family are naturally regarded with horror. "Since two or three children give us sufficient enjoyment of the pleasures of paternity, why," the greater number of Frenchmen argue, "should we have more? With two or three children we can live comfortably and save sufficient to leave our children as well off as ourselves; a greater number would entail curtailments of enjoyment both for ourselves and our children." The equal distribution of property on intestacy, and the incapacity, and indeed general unwillingness of the parents to make any much greater provision for one child than another, also operate in the same direction. Since all children share alike, if the children are to live the same lives as their parents and have the same advantages in starting in a profession or in business, the family must needs be a small one. No French parents could entertain the notion of their children and their children's children having to contend with greater poverty than they have themselves been accustomed to. Why should a fortune have to be divided among seven or eight children when, according to the family habits, it is comfortably sufficient only for two or three?

It is clear, too, that if, as a general rule, the family is limited to three children, the law of succession in France and the custom of equal division of property does not, when combined with French habits of thrift, operate so as to give the children smaller portions of property than their parents. If there are two families—A and B—each with three children and with properties of equal or of nearly equal value, and one of the children of the family A marries one of the children of the family B, the married children will, on the principle of equal division, have property equal to two-thirds of the property of either family, A or B. But with the French habits of thrift and saving the probability is that they will be better off even than their parents, for the parents of the families A and B have but to economize to the extent of one-third of either of their properties in order to leave each child as well off as they are themselves; and since, as a rule, every Frenchman lives largely within his income, this is usually accomplished.

Generally throughout Europe it is found that the families of people well off, including the families of professional people and tradespeople, are less numerous than the families of the artisan and the agricultural labourer, and this is especially the case in France. The fatal conclusion resulting from the population returns is this, that the families of the artisan and the agricultural labourer are themselves on the decrease, while the absorption of the rural populations in the towns tends still more to depopulate the country. As it is, a large share of the rural work at harvest times, and nearly all the rough work of excavation on new docks and railways, are done by Belgian, Italian, and Spanish immigrants. This absorption of the population of the country into large towns is a phenomenon of the times remarkable in other countries as well as France, although France affords the most striking instance of the tendency; and this constant set of the country populations towards the towns in France not only denudes the rural districts of their inhabitants, but the immigrants in changing a country life for a town life become themselves less reproductive, since the birth-rate in large towns is normally less than that of the country, and we know that large towns like London and Paris have their populations maintained and increased by the continued flow of immigrants from the country. Various other reasons have been put forward to explain the increasing sterility of the French nation, but after all have been examined, no valid reason can be sustained except that before-mentioned—the growing indisposition of the people to have large families; and with the increase of wealth in the country it is probable that this indisposition will increase rather than diminish.

Some have asserted that the physical vigour of the Frenchman has decreased, but there is no ground whatever for such an assertion. Density of population has been put forward as another reason; but France is really sparsely populated compared with Belgium, England, Italy, and other countries. If France were as densely populated as England and Wales she would have 72,000,000 inhabitants, and in the most densely inhabited districts of France—like the Nord and the Pas de Calais—the population really does increase.

Wars have no doubt contributed to keep down the population. It has been calculated that the wars of the second empire cost the country 1,267,276 inhabitants. The excess of deaths over births during the Franco-Prussian war amounted to 547,988, and the whole excess of deaths over births was for the five years of war of the second empire 614,840, to which must be added, to make up the loss, the number of births lost to the country by the war, and the loss of 1,634,662 French men and women by the cession of Alsace and Lorraine. Neither, however, wars nor any other cause would account for the increasing depopulation of the country districts of France, and the increasing sterility of the whole nation can have no other causes assigned to it but those of habit and calculation.

Various remedies have been proposed to meet an evil which must infallibly, if it goes on, in course of time reduce the relative power of the French nation to a degree of inferiority such as could never be produced by pestilence or war; but none of these seem to hold out much hope. The most promising antidote would seem to be a public encouragement of emigration and a spirit of foreign enterprise. If Frenchmen could be induced to follow the example of the peasants of North Italy and of the Engadine, who expatriate themselves commonly for a series of years and

go abroad and make fortunes with a view of returning and settling down in comfort in their own country, some hope might be entertained. But the Frenchman, and, above all, the Frenchwoman, have become so attached to the soil of *la belle France*, with its attractions of art and nature, that such a change of national feeling as must ensue to bring about a system even of temporary emigration seems beyond the range of probabilities. Even now it is rarely the case that a Frenchwoman will accompany her husband when he goes abroad with a good appointment and permanent employ; she prefers to let him go by himself.

From the results of an official investigation published in 1884 the value of the landed property in France is £3,535,000,000, and if the value of the buildings be added the total would probably be about £5,300,000,000, or £140 per head. The rental of landed property is £100,000,000. The total national income from all sources for 1884 was unofficially estimated at £940,000,000, or rather more than the capital of the national debt.

Constitution and Government.—The present constitution of France, voted by the National Assembly elected in 1871, bears date 25th February, 1875. It vests the legislative power in an assembly of two houses, the Chamber of Deputies and the Senate, and the executive in a chief magistrate, called President of the Republic. The Chamber of Deputies is elected by universal suffrage, under the "scrutin d'arrondissement," adopted by the National Assembly, 11th November, 1875. The law orders that each arrondissement is to have a deputy for every 100,000 inhabitants, and large fractions of 100,000 count for 100,000. There are 381 arrondissements, and by a special law some of these have been divided into parts, so that there are altogether 537 electoral districts and 557 members in the Chamber of Deputies. A town growing from, say, 190,000 inhabitants to 250,000 would have a third deputy allowed it. Suffrage is universal, but every one must have been registered at some known address six months before voting, not necessarily, however, at the same. This is in order to exclude people "sans feu ni lieu," as the French put it. Those once convicted of felony or desertion are perpetually disfranchised. There are about 10,000,000 electors. A candidate must get an absolute majority of the votes given, and a number of votes equal to one-fourth of those on the register. With 20,000 on the list, a candidate must get at least 5000; if 15,000 of these vote, he must get at least 7500. If 15,000 vote, and A, B, and C get 7000, 5000, 3000 respectively, A and B proceed to a second ballot, when a simple majority decides. On election a deputy goes to Paris, where there is a verification of his election by the Chamber. He must show that he is twenty-five years of age, a Frenchman, and that he has his civil rights, &c. The Chamber then declares his election valid or not, as it thinks fit.

The Senate is composed of 300 members. No other qualification is required for a senator than to be a Frenchman and forty years of age. The Senate and the Chamber of Deputies assemble every year on the second Tuesday in January, unless a previous summons is made by the president of the republic, and they must remain in session at least five months every year. The Chamber of Deputies is elected for the term of four years. The president of the republic has the right of convoking the Chambers for an extraordinary meeting. He is bound to convoke them if the demand is made by one-half of the number of members composing each Chamber. The president can adjourn the Chambers, but the adjournment cannot exceed the term of a month, nor occur more than twice in the same session. The Senate has conjointly with the Chamber of Deputies the right of initiating and framing laws. Nevertheless, financial laws must be first presented to and voted by the Chamber of Deputies.

Both the senators and the deputies receive payment for their services, the deputies at 9000 francs, the senators at 15,000 francs a year. If a deputy is called to order and suspended, he loses his pay, and has also to pay the cost of placarding the sentence throughout France. The president of the republic is elected, by a majority of votes, by the Senate and Chamber of Deputies united in National Assembly. He is nominated for seven years, and is re-eligible. The president of the republic has the initiative of legislation concurrently with the two Chambers. He promulgates the laws when they have been voted by the two Chambers. He watches over and insures the execution of them. He has the right of individual pardon, but cannot proclaim a general amnesty. He disposes of the armed force; and he appoints to all civil and military posts, including the heads of the ministerial departments. Every act of the president of the republic must be countersigned by a minister. The president of the republic may, with the assent of the Senate, dissolve the Chamber of Deputies before the legal expiration of its term, but in such event the electoral colleges must be summoned for new elections within three months. The ministers as a body are responsible to the Chambers for the general policy of the government, and individually for their personal acts. The president of the republic is responsible only in case of high treason. By a special article, appended to the constitution of 1875, dated 16th July, 1875, it is enacted that "the president of the republic cannot declare war without the previous assent of the two Chambers." In the event of a vacancy by death or any other cause, the two united Chambers must proceed immediately to the election of a new president. The salary of the president is fixed at 600,000 francs, or £24,000, with an additional allowance of 300,000 francs, or £12,000, for household expenses.

Church and Education.—The population of France, at the census of December, 1881, consisted of 29,201,703 Roman Catholics, being 78·50 per cent. of the total population; of 692,800 Protestants, or 1·8 per cent. of the population, as compared with 584,757 in 1872; of 53,436 Jews, and 7,684,906 persons "who declined to make any declaration of religious belief." This was the first census at which "non-professants" were registered as such. All religions are equal by law, and any sect which numbers 100,000 adherents is entitled to a grant. As a matter of fact, only the Roman Catholics, Protestants, and Jews have state allowances. In the budget for 1884 these grants were as follow:—

	Francs.
Roman Catholic prelates and clergy, . .	40,350,000
" " churches, seminaries, &c.,	9,200,000
Protestant clergy and seminaries, . . .	1,600,000
Jewish rabbis and seminary, ...	200,000
Protestant and Jewish places of worship,	100,000
Mussulman priests and *matériel* (Algeria),	220,000
Total,	. 51,670,000
	= £2,070,000

There are eighty-seven prelates of the Roman Catholic Church—namely, seventeen archbishops and seventy bishops. The secular clergy of the Catholic Church number about 55,000. The Protestants of the Augsburg Confession, or Lutherans, are in their religious affairs governed by a General Consistory, while the members of the Reformed Church, or Calvinists, are under a council of administration, the seat of which is at Paris. There are 700 Protestant pastors, and sixty-six Jewish rabbis and assistants. The government appoints the archbishops and bishops, the pope merely conferring on them canonical investiture. The heads of the church appoint the inferior clergy, subject, however, to the approval of the government. Before the first French revolution the country abounded

in monastic establishments for both sexes, some endowed with vast possessions. The abbeys and convents have been mostly abolished.

Public education in France is entirely under the supervision of the government. The highest schools, or universities, go by the name of "facultés de l'état," and are fifteen in number, at Paris, Aix, Besançon, Bordeaux, Caen, Clermont, Dijon, Douai, Grenoble, Lyons, Montpellier, Nancy, Poitiers, Rennes, and Toulouse.

At the census of 1872 there was an official inquiry into the educational state of the nation, which was very carefully made, and showed that nine-tenths of the children under six; more than a fifth, but less than a fourth of the youths of both sexes under twenty; and more than a third of the grown-up population of men and women were unable to read or write. Setting aside the 4,000,000 children under six years of age, it may be said that 30 per cent. of the population of France were then entirely devoid of education. Since the year 1872 the progress has been very great, owing to the energetic efforts of the government, aided by the legislature, primary education being now compulsory. It was stated by the minister of public instruction in the Chamber of Deputies, in the session of 1881, that all children, without exception, would be subject to education before the end of 1883.

Revenue, Expenditure, and Public Debt.—From the year 1853 to 1869 the expenditure increased from £62,000,000 to more than £76,000,000 per annum. In order to meet constant deficiencies the government had recourse to several loans, which proved highly successful—borrowing, not from a few large banking houses acting as agents, but directly from the people, or the mass of small capitalists both in France and other countries, but chiefly, of course, France. For a loan of 450,000,000 francs issued in 1868, more than 15,150,000,000 francs (thirty-four times the sum required) were offered by 781,292 subscribers.

Under the first Napoleon revenue was generally made to meet expenditure, and the whole of his wars added less than £6,000,000 to French debt, his famous maxim, that "he would make war support war," being almost literally adhered to. After his fall, however, it was found that his wars really involved the country in serious expense, for the Restoration had to provide very large sums to meet various indemnities and the cost of occupation by foreign armies. Consequently, from 1814 the debt and the annual budget enlarged by rapid strides. The debt was £220,648,000 in 1842, and rose in 1870 to £500,000,000, the increase being largely due to the Crimean, Italian, and Mexican wars. The few brief but disastrous months of war from July, 1870, to February, 1871, and the succeeding events of the Commune, nearly doubled the national debt!

The total outlay involved by the war with Germany in 1870–71 was found to have been considerably more than £400,000,000, without taking account of devastated homesteads, of ruined harvests, of industry suspended, or of household or national treasures destroyed, ransacked, or scattered. The direct cost of the war was £123,000,000; the maintenance of German troops, and repayment of sums exacted by the German armies during the occupation, absorbed £24,000,000; loss of revenue by non-payment of taxes during the war, £24,000,000; necessary compensations for property actually destroyed and army *matériel* necessarily replaced, £20,000,000; and indemnity, £200,000,000. Interest, however, on the latter sum was exacted by Germany until its complete payment, and this, with the cost of transferring the huge sum, added £12,596,706 to the indemnity.

It was stipulated that Germany should be paid in either gold or silver, or notes of the banks of France, England, Prussia, Holland, or Belgium, or bills payable to order, or bills of exchange drawn upon the countries just mentioned, and of first-class negotiable security. The whole of the indemnity was paid considerably before the time originally stipulated, but even in the short space of time between 26th of February, 1871, when the terms of peace were agreed to, and 5th September, 1873, when the last instalment was paid, interest upon such a stupendous sum would assume large proportions. Interest and discount together made the indemnity up to £212,596,706. To complete the gains of Germany by the war, the sums must be added which she levied as war contributions on French cities, amounting to £10,052,337, making the total handed over to Germany £222,649,943 sterling. The payments were made by means of two loans for two and three and a half milliards respectively, and was handed over in thirty-three partial payments.

Notwithstanding, however, the heavy drain upon the resources of France, her credit remained unshaken. At the most critical period of the Communist insurrection, or at the time when most of the large southern towns were in a state of chronic revolt, and when two-thirds of the departments were occupied by the enemy, the 3 per cents. sold concurrently at Lyons, Bordeaux, and Marseilles at 54 francs or 55 francs. In 1848, amid events far less disastrous, the 3 per cents. fell to 37 francs. During the interval the wealth of France had increased in an enormous proportion; and whatever faults the empire may be charged with, the twenty years of tranquillity it gave to France was accompanied by a progress of material prosperity perhaps more rapid than was ever attained in so short a space of time. The number of proprietors of the public funds, which had been but 500,000 in 1848, had risen to more than 4,000,000 in 1884. The *rente* has penetrated deeply into the lower strata of society, giving the whole nation a personal interest in the sincere fulfilment of its obligations; and it is to be remarked that among all the wild schemes put forward by the revolutionists that of repudiating the public debt has never been one.

The great loan of 1872 showed in a singular manner the stability of French credit. In June, 1872, a treaty was agreed to with Germany for the purpose of hastening the payment of the war indemnity and the evacuation of the occupied departments. Special advantages were offered to France if the remainder of the indemnity (£100,000,000) were paid quickly, and in order to do that and meet some other claims, it was determined to contract a loan of three and a half milliards of francs—about £140,000,000 sterling. The desire manifested to have a share in the loan was intense, and when the accounts were finally made up it was ascertained that the subscriptions amounted, not to three and a half milliards, but to forty-three milliards, or £1,720,000,000 sterling! The greatest part of this enormous sum was offered by the French themselves, whose hoards came forth more readily even than when they were invited by the imperial loans of Napoleon III. A vast amount was proffered by England and Germany—in fact, the German subscription alone would have sufficed to cover M. Thiers' original demand. It proved, however, a far more easy task to obtain loans than to provide for the expenses they entailed; and it is only by the exercise of great financial sagacity on the part of the government, and a patient submission by the people to taxation, that France is able to supply the heavy additional sum with which she is now annually burdened.

Altogether the war added £23,000,000 sterling to the expenditure, and nearly four years elapsed before the National Assembly succeeded in establishing an equilibrium between income and outlay. At the close of the war it had been found necessary to reorganize the army, reconstruct the fortresses, and reconstitute the *matériel* of war. The work is not yet completed, and it is estimated to cost very nearly two milliards of francs, or £80,000,000 sterling. That was a task which could not be postponed if France was to resume her position in Europe. It was,

however, considered that the defeat of France was due, not alone to her inferior military organization, but partly also to the want of education of her people, and to her deficiency in railways and other means of communication. Accordingly, as soon as the finances seemed to permit it, a plan was adopted for building a vast network of new railways, improving the river and canal navigation, and constructing harbours. A scheme followed for endowing the country with schools and colleges and giving gratuitous primary instruction.

So great was the drain caused by all this expenditure, that in 1883 the minister of finances was compelled to recognize that if the system of public works in which the government had engaged was carried out on the plan sketched the results would be disastrous. He set himself, therefore, to find a remedy. The majority in both Chambers were resolved that the public works should be constructed, but yet the condition of the finances required that they should not be continued at the expense of the government. M. Tirard, therefore, addressed himself to the great railway companies, and inquired if they would undertake the building of the new railways. The companies agreed to do so, and conventions were entered into by which the companies bound themselves to construct a definite number of miles of new railways within a given time. A part of the expense is to be found by the companies, and a part is to be borrowed by the companies for the government, the latter paying the interest upon it. But the government is relieved altogether from the trouble of building the lines, and also from the obligation to find the money.

The following is a statement of revenue and expenditure of France for the ten years from 1874 to 1883:—

Years.	Revenue.	Expenditure.
	£	£
1874	104,342,019	111,295,327
1875	114,811,205	117,441,107
1876	127,479,482	121,226,322
1877	115,830,238	121,095,829
1878	137,096,913	133,912,438
1879	139,613,695	132,964,877
1880	141,232,931	134,583,108
1881	133,503,700	136,246,197
1882	132,706,848	132,614,756
1883	142,967,845	142,956,313

The expenditure to be provided for in 1884 was £153,650,000, or at the rate of £4 per head of the population!

As regards the debt of France, it is difficult to state its exact amount, partly because the French mode of book-keeping in this respect differs altogether from that of England, and partly because so much of the French debt is contracted for short periods, and is being paid off. Speaking generally, however, it may be said that the capital of the consolidated debt in 1884 amounted to about £920,000,000 sterling. To this, of course, has to be added the enormous floating debt of all kinds, the capitalized value of which it is impossible to state. The charge of the debt proper in 1884 amounted to £44,000,000 sterling. Of this enormous charge £28,000,000 sterling were applied to the consolidated debt, and the remainder was absorbed in the interest and redemption of the debt for short terms. Pensions of all kinds amount to another £6,500,000. Therefore the whole charge for interest and redemption of the debt and for pensions somewhat exceeds £50,000,000 sterling—an oppressive burden for a country certainly not richer than the United Kingdom, and with a population almost stationary. But it must not be forgotten, on the other side, that the whole of the railways of France are only leased to the railway companies; that about the middle of next century the leases will all fall in, and that even now the capital value of those railways is estimated at about £600,000,000 sterling. It is, of course, a long time before they will become the property of the state, and for the present they are a charge, not an advantage. Moreover, the interest the government will have to pay on the cost of the new lines makes them still more of a burden.

Justice and Crime.—The Revolution swept off the corrupt system of jurisprudence then existing, and the endless and flagrant abuses that had grown up under it. The present civil and criminal law of France has been embodied in codes drawn up under the auspices of Napoleon I., with singular perspicuity and brevity. The country is divided for judicial purposes into tribunals of "first instance" and superior courts—there being of the former one for every arrondissement, and of the latter twenty-seven in the whole empire. Above all is one court of high appeal, the Cour de Cassation, which sits in Paris. The trials in "first instance" take place before three judges; in the superior courts before five or seven; in the Court of Cassation before twelve. In criminal cases a condemned man has three appeals—that is, to the court of the arrondissement, the superior court, and the Court of Cassation; after these all that remains is the *recours en grâce*, which the counsel of a prisoner under sentence of death or penal servitude transmits to the president through the minister of justice. It cannot be said that, as a rule, the *procureurs*, or public prosecutors, come up to a satisfactory standard. They are a very ill-paid class, and as their emoluments are too small to tempt men who have the slightest chance of making their way at the bar, the government is obliged to select from those who, however honest and painstaking, are at best lawyers of quite second-rate capacity. The procureur and his deputies sit every day and divide the business between them. When a defendant appears to answer a summons, or comes up in custody under warrant, his examination is conducted in strict privacy. If the charge seems a frivolous one, or if the *primâ facie* evidence be insufficient, the procureur may at once dismiss the case; in the contrary event he hands over the *inculpé* to the examining magistrate, or *juge d'instruction*, who either liberates the defendant on bail (though this is very rarely done) or orders his provisory incarceration under a *mandat de dépôt*. The trials in the police correctionelle never last long, the system of examining the prisoner tending to betray his guilt when guilty, and serving on the other hand to establish his innocence, if innocent, in a speedy and certain manner. A prisoner has certainly a harder time of it in France than in England, but there can be no doubt that under the French system many criminals are convicted who would escape in a British court; while there is no proof that more innocent persons are found guilty there than here. Sentences in the police correctionelle may vary from one day's to five years' imprisonment.

In the Court of Assize the proceedings are altogether more formal, and allow a prisoner rather a better chance of an acquittal. The oath which the jury is made to swear is an extremely beautiful one, and it is impossible to hear it without feeling moved. Lifting up their hands one after another they declare that "without malice and without favour, without prejudice and without weakness, they will examine the evidence with an impartial desire to ascertain the truth, and convict or acquit as they shall consider just on their honour and conscience as honest men." There are three judges at the assize trials, as at those of the police correctionelle, but the same reproach may be addressed to the former as to the latter, of nearly always summing up against the prisoner. As a compensation, however, French juries are extremely jealous of their prerogatives, and not unfrequently acquit solely to assert their independence.

The verdict is not rendered by "guilty" and "not guilty," as in England, but by the answer "yes" or "no" to a long series of questions enumerated by the presiding judge. In cases of murder with robbery these questions sometimes amount to as many as fifty or sixty, for the indictment is made to include all the minor counts of aggravated assault, simple assault, &c., so that if the prisoner is acquitted on the charge of murder there shall be no need to begin a fresh trial to convict him of manslaughter.

In France it is with the jury that lies the prerogative of admitting "extenuating circumstances;" in Belgium it is with the judges. There is much to be said for both systems, the main objection to the French method being that juries often admit "extenuating circumstances" simply because they object to capital punishment.

The terms "transportation to a fortress" and "transportation for life" in France are apt to suggest misapprehensions to those who judge of French penalties by English. Excepting penal servitude (*travaux forcés*), which is a truly unpleasant thing, but is scarcely ever inflicted in political cases, French punishments are not very harsh for prisoners who have money. A man sentenced to transportation must rough it if he be penniless; but otherwise he undergoes no greater hardship than that of being obliged to live within certain prescribed limits and having to report himself daily at stated hours to a commanding officer. It is garrison life without the uniform. A political convict of any status generally has his apartments as if he were at home. He may read, write, walk about his fortified town pretty much as he pleases, and have his family to live with him. The only circumstances where severity is used are those where the prisoner is intractable, and declines giving his parole not to escape. As for political imprisonment in France, it is not going too far to describe it as little more than a mere pretence. When a man may receive his friends, give them a dinner, play music to them, and edit his newspaper in his "cell" (which is generally a very cosily furnished room, at least at St. Pelagie), he cannot be said to suffer very painfully for truth's sake.

Army and Navy.—The military forces of France have undergone complete reorganization since 1871. The law which now regulates them was passed in 1872. It enacts universal liability to arms, forbids substitution or enlistment for money, and orders that every Frenchman not declared unfit for military service may be called up, from the age of twenty to that of forty years, to enter the active army or the reserves. The course of service is five years in the active army, four years in the reserve of the active army, five years in the territorial army, and six years in the territorial reserve. The law formerly exempted from service in the active army young men with a certain amount of education, who enlisted as volunteers for one year, and during that time maintained and clothed themselves at their own expense, and also young men who were training for the priesthood. These exemptions were, however, abolished in 1884. The French system is largely founded on German ideas, and is expected to furnish in time of war about 1,500,000 effective men. Its various details were fully elaborated in 1875, and should the system work well until 1892 France will then have at its command 2,750,000 thoroughly trained fighting men, organized on a plan embracing all the most efficient features of the German system, without those which were supposed to constitute its weakness; but the spirit of discipline is still wanting among all classes in the army. A series of sites have also been selected for new systems of fortifications on the frontiers, and for a series of entrenched camps in strategic positions, which will materially strengthen the powers of armies in the field. The system of entrenched camps was decided upon long before the Turks at Plevna afforded so striking an example of what could be achieved by this mode of warfare.

Nothing is more significant of the determination of France to recover its former military prestige than the unanimity with which the military and naval charges are always voted. The cost of the army in 1869 was £15,400,000, while in 1884 it had increased to £24,200,000. Whatever else in the budget may be questioned or disputed the largest demands for military and naval purposes are passed with cheerful approval. And the same patriotic zeal appears to animate all classes of the country, thus rendering the carrying out of the very onerous army laws a comparatively easy task.

The French navy is manned by conscription and enlistment, and the minister of marine can always man his fleets very quickly by summoning the men entered on the "inscription maritime"—an institution which dates from 1683. It is a list which includes all Frenchmen who are supposed to lead a seafaring life, that is, fishermen and men who at the age of eighteen have made two foreign voyages (*au long cours*) in merchant ships. A man remains inscribed from his eighteenth to his fiftieth year of age, and the number of registered sailors thus amounts to about 180,000. For the ordinary service of the navy a draft is taken yearly by conscription of men who have completed their twentieth year, and the time of service is the same as for the army, with similar conditions as to reserve duties, furloughs, and leave of absence for lengthened periods. The naval conscript who draws a "good number" is generally made to serve six months ashore in the arsenals, dockyards, or among the divisions of seamen stationed at the naval ports; but if he draws a number which gets him enrolled for general service in the fleet he spends about three years on board a man-of-war, and is then discharged on furlough, which is renewed every six months for two years. During this furlough time he draws no pay. At the expiration of the two years he passes into the first-class of the naval active reserve, where he remains for two years more and is liable to be called at any moment, unless he undertakes to employ himself only in coast fishery or in coasting vessels, in which case his work counts as active service to the state, and he will only be called for duty in the fleet in cases of great emergency. From the first-class of the reserve the *inscrit* goes into the second, where he stands till his fiftieth year; but in calling out the reserves care is taken, as far as possible, to exempt pilots, masters, married seamen with families, and able seamen who have signed engagements for long voyages. These classes would only be made to serve if the supply of ordinary reservists were quite exhausted. By an Act passed in 1872 young men liable to service in the army may select to enter the navy, if recognized fit for the duties, even if they be not enrolled in the inscription maritime; and a soldier who after his discharge acquires a taste for seafaring life may, on giving proof of his aptitudes as a seaman, get transferred from the military to the naval reserve. Properly, the men on the inscription are liable for service in the fleet at eighteen, but they are seldom drafted till twenty, and thus escape two out of the five years which they are nominally supposed to serve. The time of service, so far as pension rights are concerned, dates always, however, from the day of inscription. The effective war navy of France was composed in 1884 of fifty-six ironclads, 170 unarmoured screw-steamers, twenty paddle-steamers, and fifty-six sailing vessels. The budget of 1883 provided £8,440,000 for the cost of the navy, but this includes also the cost of colonies.

In 1780 the French fleet of war consisted of sixty first-class ships, twenty-four second-class, and 182 smaller vessels—altogether 266 ships, with 13,000 guns and 78,000 sailors. In 1790 the number had decreased to 247 ships, with 51,000 sailors and less than 10,000 guns; while at the battle of Trafalgar (1805, in which the greater part of the imperial naval force was engaged) there were only eighteen French men-of-war, with 1352 guns. In 1844

the navy had increased to 226 sailing vessels and forty-seven steamers, and this strength was not increased till the year 1855, when the government ordered the entire reorganization of the navy. While army reconstruction has been so actively carried out of late years, the navy has been by no means overlooked, and great efforts are being made to add to it vessels of the newest and most formidable type.

Agriculture.—France has always been considered one of the most agricultural countries in Europe, but in most parts the progress towards a general adoption of improved methods of cultivation was very slow until the reign of the late emperor, and except in the north-western departments it has not yet kept pace with the general advance of agriculture in Western Europe. It is true the gross produce of the country is double what it was eighty years ago; but whereas in the centre of the country the yearly yield per hectare has advanced only in the proportion of from four to six, in the north-west it has increased in the ratio of from four to nine.

A useful division of France, in respect to its agricultural capabilities, is that into four regions, proposed by Arthur Young eighty years ago. In the northernmost region the vine does not thrive so as to make good wine. The next division, towards the south, is that in which wine is made, but maize or Indian corn does not thrive. The third division, still further south, is that in which both maize and wine abound, but where the climate is still too severe for the olive or the white mulberry. The last division consists of the southern provinces, where the olive and the mulberry are grown, as well as maize and the vine. In this part the year often yields two harvests of corn, but the soil is not well adapted to permanent pastures, except at a considerable elevation.

With the exception of wheat, of which upwards of 300,000,000 bushels are grown annually, the culture of corn has not increased much during the present century: but the growth of the vine, artificial grasses, pulse, and above all potatoes, has been very considerably augmented, especially during the last fifteen years. Beet-root is extensively grown for the manufacture of sugar. It was introduced for this purpose during the wars of the early part of the century, and at present more than 300,000,000 pounds are annually manufactured. Since the appearance of the vine disease beet-root has also been extensively employed in the manufacture of alcohol. The mulberry tree is cultivated to a great extent for the production of silk, especially in the department of Gard. France is abundantly supplied with fruits. Where the culture of the vine ceases that of apples and pears becomes of considerable importance, and in the north cider and perry are the ordinary beverages of the inhabitants. The cider of La Manche and Calvados is the best, and some of it is drunk even in the wine departments. In the department of the Eure almost all the roads are bordered by a double or triple row of apple-trees, and large quantities of the fruit are exported to England and elsewhere. Cider is sometimes used in the distillation of brandy. Several of the central departments are famous for their dried pears, and others for their prunes and cherries. In the Vosges the latter is extensively used in the manufacture of "kirschwasser." Chestnuts are very abundant in some of the central and southern departments, and form the chief food of the rural population during half the year. The olive was formerly more cultivated than at present: the climate, even in the most favourable situations, does not seem altogether suitable for the plant. The esculent roots and table vegetables are common. Flax, hemp, and tobacco are cultivated in various parts of the country, and to a considerable extent; hops and madder in a small degree; and colza and rape, for oil, are grown in the north. The arable land and pastures are seldom intermixed, as in England, but generally lie wide of each other. The horses and cows are fed chiefly on clover, lucern, sainfoin, and other artificial grasses. The average yearly produce of the vine is about 1,380,000,000 English gallons, of which about one-seventh is converted into brandy. It has now become the practice to import foreign wines, especially Spanish, for mixing with various manufactures, which are sold and exported as genuine French wines. Of timber trees France has a very fair supply, including the oak, elm, beech, ash, chestnut, and pine.

The land of France is chiefly occupied by small proprietors. Almost all the great properties have been gradually broken up. Property has been divided generally into three classes, about 50,000 properties averaging 600 acres, about 500,000 averaging 60 acres, and about 5,000,000 averaging 6 acres. The first and second classes are fast merging into the third. In many departments 75 per cent. of the agricultural labourers are proprietors. The parcels of land held by them are often not more than a rood in extent, and very often separated by considerable distances, and this parcelling out of the land is increasing every day. Land is also occupied by tenants holding from proprietors and *métayers*, but these are in many instances small proprietors themselves. It must be borne in mind that the principle of the law of descent of land in France at the death of the owner is that of its equal distribution among his children, though he has liberty to leave to others defined portions of it, ranging from a quarter if he has three children to a half if he has only one child; and a like liberty is allowed where, in default of children, the succession is in the collateral branches of the family. Agricultural produce is classed as follows:—1, Cereals and other alimentary produce; 2, industrial cultivation: under these two heads are comprised grain and vegetable crops, hemp, flax, hops, madder, beet-root and other roots, tobacco, and silk produce; 3, vines; 4, fruit; 5, pasture and cattle. The small proprietor does not follow any fixed rotation of cropping, but cultivates according to circumstances, and on small properties stock would rather embarrass than benefit the proprietor. He purchases, as occasion offers, what he requires from the cattle-breeding districts, and what his plot of land can support. On the other hand, in the departments composed almost exclusively of pasture land, 1500 cows may be found upon 2000 acres. A want of stock in proportion to the land under cultivation prevails, therefore, in many districts, although the number of cattle is increasing.

Forest land occupies a sixteenth part of the area of France. The use of thrashing machines is becoming very general; mowing and reaping machines are less common. What is termed the hired labourer in England corresponds in France to the *valet-de-ferme*, or farm-servant; these live with the master, and in fact form part of his family. They are comparatively few in number. Their wages average from £10 to £12 a year for men, and from £5 to £7 for women; and they are lodged and fed at a cost of about £10 a year per head. Female labour is much employed, especially in the northern departments. Agricultural labour is generally deficient throughout France. The migration of the country population to the great towns is increasing. The vast municipal improvements undertaken of late years have produced a rise of wages in the towns which attracts the peasant, and thus increases the evil so far as land is concerned. The wages of the agricultural labourer (as distinguished from the farm servant) have, in consequence of this migration to the towns, increased considerably; and he can now earn, on an average, 2*s.* 6*d.* and 3*s.* per day, and in some districts much more. The French agricultural labourer, or, it may be, small proprietor, does not emigrate to foreign countries; if he is a small proprietor, he will seldom move even from his native place. These men will generally be found living on and cultivating their properties. Their condition of life depends very much upon the local circumstances of their tenure of

land, the facility of communication, and the consequent price of provisions; if not always contented, they are at least comfortable. The decrease in the number of children in the families of the peasantry is a fact fully established by the *enquête agricole*, and it was generally remarked by those to whom questions on this subject were put that there was a progressive tendency to diminution. The labourer who has become a proprietor is rendered prudent, and he fears that his plot of land might become too much divided. Tenants receive no assistance by law in their endeavours to become proprietors; they become proprietors almost from the nature of the system, and the law tends on principle to the division of the land, and to the still further parcelling out of the already prevailing small properties.

Animals and Fisheries.—The domesticated animals of France are for the most part similar to those of Great Britain. Improvements have recently been made in the breed of horses, but they are still by no means equal either in number or excellence to those of England. The ass, though superior to that of Great Britain, is inferior to that of Spain or Italy. Mules are bred in many parts, and some are exported. Oxen are much employed in the labour of the field instead of horses. The sheep are of various breeds, some of which have been so far improved as to furnish a wool equal to that of Saxony. Some goats are bred in the mountainous departments, and the Tibet goat, whose hair is woven into the Cashmere shawls, has been naturalized in the Pyrenees. The swine are of three races. The trade in salt provisions forms an important branch of industry in some of the departments. The rearing of poultry and bees is much attended to. The estimated value of the former is over £8,000,000, while in England it is not more than a tenth of that sum. A great quantity of the immense amount of honey consumed is supplied from the island of Corsica and from Brittany—the annual value of the honey and wax produced in Corsica alone being £5,000,000.

Of wild animals there are some which are not found in England. The black bear and brown bear still have their haunts in the French Pyrenees: the lynx is found, though very rarely, in the recesses of the higher Alps; and the wolf and the wild boar are common in the larger forests. The chamois and wild goat are found on the summits of the Alps and Pyrenees. The stag, roebuck, hare, and rabbit are common. The fox, marmot, ermine, hamster, and squirrel are plentiful; as are likewise the smaller beasts of prey and vermin, such as the badger, hedgehog, polecat, weasel, rat, mouse, mole, and field-mouse.

Of birds, the chief songsters and the birds of passage are much the same as in England, with the addition of the hoopoe and one or two others. The wanton destruction of small birds in France, which was carried on for several years, was attended with such an alarming increase of noxious insects, that most stringent provisions are now in force to prevent such a foolish and cruel proceeding. Game is generally very plentiful.

The tortoise, salamander, scorpion, and a kind of spider closely resembling the tarantula of Italy, are found. The bee and the silkworm are the most valuable insects; and the Spanish fly is sufficiently numerous to furnish an article of exportation.

The coasts abound in fish of various kinds, the taking of which engages about 18,000 hands: the oyster, herring, mackerel, and especially the sardines—of which immense quantities are exported—are the chief objects of attention to the fishermen on the coasts of the Channel and the Atlantic; the tunny and the anchovy to the fishermen of the Mediterranean. The French government expends about 4,000,000 francs annually in aiding those engaged in the great fisheries; and it appears from official returns that, besides the men employed in taking the fish, there are about 16,000 persons occupied in preparing and salting them.

French Town Life.—French second and third-rate towns have this common character, that every class in them lives apart, or secluded from the other, without being connected by any of those ties which the habit of public life and political intercourse have woven between the various classes in England. If there is in such towns a class of workmen, they live apart under republican influences; the shopkeepers alike club together, and form the most timid and quiet part of the population. There is, however, in these provincial towns, or rather above them, something which never changes nor moves, but which also never sleeps —it is the Roman Catholic Church, much more powerful there than in the wholly rural districts. The power of the church has been on the increase for thirty years in the smaller provincial towns, and the clerical influence has wonderfully progressed during that period among that same French *bourgeoisie*, upper and lower, which had formerly thrown off so decidedly its allegiance to the church. It is believed now, in provincial life, a blemish and a fault, not only if you are an opponent to the church, but even if you are not reckoned among its supporters and friends. The old Voltairianism, as it was termed, has disappeared from the upper and middle provincial classes, to subsist only in a part of the youth, where it becomes mere materialism or positivism, and also among the workmen, where infidelity is only one of the phases of the struggle still raging between the Catholic Church and the Revolution.

Marriages are often settled like a business matter by the parents or legal advisers of the family; therefore, what is called a *mariage de raison*—that is, a marriage which a reasonable interest has decided—is most frequent in France, and is a kind of moral law of the land. Notwithstanding this, the pictures of French married life drawn by sensational novelists are greatly exaggerated. The French family is far from being worse than elsewhere, and as a rule it is united, and holds together in trouble. The excessive love for the children maintains and protects the family; both parents, whether bad or good, feel bound to their children by indissoluble ties, and that it is their duty to protect them, to guide them, and to control them so long as life endures. So strong is this feeling that parents in France have asked for and have obtained an entire system of laws which would in England be considered insupportable tyrannies, and have in return submitted to obligations, especially in pecuniary affairs, of which Englishmen never dream. The parents can peremptorily forbid a marriage, even when the children are grown up, the single loophole —the right of the children, by a formal application to a judge, to compel the father to produce sufficient reason— being so rarely used as to be considered discreditable. To put the law in motion for "a respectful summons" is of itself to put the applicant out of the pale of the better society. The law, indeed, allows the parents in extreme cases to use positive restraint, through the intervention of a court; and though this is rarely resorted to, the rule registers and confirms the French theory of the relation between the parents and their children. Even when the husband and wife are separated by decree they act together as regards their children, and are together liable, if they are madly extravagant, to family intervention on the children's behalf. In return, all property in France is subjected to perpetual entail for the benefit of the children, who are exempted as regards inheritance by law from parental caprice. Neither father nor mother can will away property, even if self-acquired, at their own discretion. On the other hand, the children submit all their lives to their parents, and regard them with a feeling which in England, especially among the poor, is comparatively unknown, or considered slightly sentimental and ridiculous. No excuse whatever short of treachery on her part is held by French opinion to justify a son, whatever his age, in "impiety"—that is, in insolence—towards his mother.

Manufactures, and Condition of the Working Classes.—Every branch of industry in France has undergone vast improvement since the peace of 1815. The energies of the nation being turned from war to domestic employments, speedily repaired the evils which the country had suffered.

In extent, variety, and value of manufactures, France takes high rank, and is in some departments unrivalled, but suffers in competition with England as to the amount of production, owing to the comparative scarcity of coal, which limits the employment of steam-power. The fabrics which involve artistic design, minuteness of detail, elegance of finish, and the application of chemical knowledge, are superior to those of any other nation. France is unrivalled for her silk manufactories, the finest of which are at Lyons, Tours, and Paris. The department of the Loire, and more especially the manufactory of St. Etienne, is the special seat of the ribbon trade. A great part of the raw silk was formerly produced in the country, but of late years the silkworms have been attacked by a fatal disease—referred by practical men to a blight which has attacked the mulberry tree—which has reduced the production at least one-half. Experiments have been made to raise them on other leaves; to introduce fresh species, accustomed to a different vegetation, from Japan; and also to cultivate silk in Algeria, where the experiments have hitherto been attended with great success. Alençon, Bailleul, Lille, Arras, Caen, and Bayeux are all famous for their laces and blondes. Scientific instruments, tapestry, clocks, watches, articles of *vertu*, and other costly products, are made in great perfection at Paris, and porcelain and glass at Sèvres, in the vicinity. Fine woollens and merinos have their great centres at Rheims and Amiens; cottons at Rouen; linens at St. Quentin; carpets at Abbeville and Aubusson; paper at Annonay; and gloves at Grenoble and Paris.

France is celebrated, in manufacturing industry, for having long provided means to adjust those disputes between masters and workmen which in England have so often led to "strikes" and "lock-outs," disastrous to both parties. With this object in view a *Conseil de Prud'hommes*, or "council of experienced men," was established at Lyons by a decree of Napoleon I. in the year 1806, which provided for the erection of similar tribunals wherever they might be required, and in 1807 Rouen and Nîmes obtained them. There are now several in Paris, and from seventy to eighty in the provinces. These councils are composed of equal proportions of masters and artisans, popularly elected, with a president and vice-president appointed by government, who need not belong to either class. They proceed, in the first instance, simply as courts of conciliation, suggesting arrangements, but have power to adjudicate and enforce decisions.

In France the working life of the artisan begins early, the law recognizing a child of eight to be fit for eight hours' labour in a factory or workshop; and when he is four years older, considers him capable of working twelve hours out of the twenty-four. Before a child can be thus turned to profitable account it must be proved that he has received primary elementary instruction, or that he attends a school in the neighbourhood of the shop. Apprentices cannot be taken by any one who is under age, or who has been found guilty of an offence against public morality. The master, or patron, as he is now generally called, is bound to thoroughly instruct the apprentice in his calling, to watch over his conduct like a father, see that he is not employed in any work beyond his strength or in itself unhealthy; and if he is not fairly proficient in reading, writing, and arithmetic, or his primary religious education has been neglected, must allow him two hours every day to make good the deficiency.

Fines and imprisonment await any one seducing workmen to pass into foreign employment. Any one revealing the secrets of the factory in which he is employed is liable to a fine of from sixteen to 200 francs, with imprisonment of from three months to two years; but if the offence is committed for the benefit of foreigners or Frenchmen living abroad both fine and imprisonment are much heavier. Strikes are not, strictly speaking, illegal, but the penal code declares that whoever by violence, menaces, or fraudulent manœuvres, shall bring about, or attempt to bring about, a cessation of work, with the object of forcing a rise or fall in wages, or infringe the free exercise of industry, shall be punishable by from six days' to three years' imprisonment, and a fine of from 1600 to 3000 francs; and that workmen, employers, and contractors who by any concerted means infringe the free exercise of labour shall be fined to the same extent, and be imprisoned for from six days to three months.

As a rule twelve hours make a working day in France, out of which two are allowed for breakfast and dinner. In some trades men are paid by the hour; but payment by the day is most general, although the piece-work system is rapidly gaining ground. In the towns six days go to the week, but in the provinces, where wages are lower, they reckon seven, but give the Sunday, or part of it, to the workman.

There is no want of institutions for benefiting the artisan. There are *crèches*, where children in arms are taken care of for 2*d.* a day while their mothers are working; there are *salles d'asile*, where children of tender age receive instruction in fifteen-minute lessons; there are *écoles primaires*, where older ones are taught reading, writing, arithmetic, grammar, geography, physical science, mathematics, and surveying — the two last-named institutions being free everywhere to children whose parents are too poor to pay, and free altogether in the capital. At Châlons, Aix, and Angers are government schools, intended to rear good foremen, where theoretical and practical instruction in various trades is given; and most manufacturing districts have their technical schools, to which the workmen flock with avidity. Then there are savings banks, taking deposits of a franc, and allowing compound interest. By investing 1*d.* for every working day in an annuity society the artisan can insure £20 a year upon reaching the age of sixty; and to have aid in sickness, and his burial expenses paid, he has but to join a *société de secours mutuel*, the managing committee of which is named by the members themselves.

A very small proportion of the workmen of Paris are native Parisians. They come from all quarters of the country, and for the most part return to it. Genuine Paris workmen are, as a rule, more sociable than others, more frank and less narrow-minded. They are generous in assisting one another and tolerant. They have, however, an irresistible love of pleasure and dissipation, and, above all, are constantly on the lookout for change. Their tolerance and friendliness also cease when their employers' interests are concerned. Nothing can remove from their mind the idea that the capitalist is a vampire feeding upon their blood. In the rural districts, although the wages are low, actual distress, unless caused by exceptional vice, is rare, and most of the workmen save money, the great ambition being to possess a small vineyard. But the intense desire for an equality in circumstances and position is, wherever it is powerful enough, disintegrating society in France.

The aristocratic feeling very highly prevails among those who can claim any distinction of birth or lineage; and in some parts of the country the caste feeling in its genuine feudal intensity is peculiarly strong. Great social value is attached to the right of prefixing the particle *de* to the surname, and as a matter of course it is often fraudulently assumed by the vulgar rich; nor does it, curiously enough, seem to make much difference after a time whether the coveted prefix is real or borrowed. While there is thus a constant manufacture of *pseudo*-nobility

going on, there is side by side with it a continual process of degradation, by which the real nobles lose their nobility.

The very wealthy do not at all abound in France, but gentlemen with comfortable incomes which, with careful management, may procure all the luxuries of life, are very common. The law of the division of property militates against either very large estates or very large incomes, and has made great nobles, such as were common in the days of Louis XIV., an impossibility. Many of the great castles built by these men still exist, but are out of all keeping with the establishments maintained in them. It often happens that the proprietor lives quietly with two or three servants in a tower or wing of his ancestral palace.

No one is ashamed of saving, for thrift is the rule in France, especially with the vast numbers of the people who may be called the middle classes. They are economical to a fault, and their thrifty habits form the great financial strength of the country. A middle-class Frenchman almost invariably lives so as to have something to his credit at the end of the year; if he is rich the balance is large; if poor, it is small; but, unless in exceptional circumstances, it is always there. Very few Frenchmen burden themselves with more servants than are absolutely necessary for household requirements; and it is to a great extent in this liberty to spend or not as one may choose, in this freedom from the tyranny of custom in the matter of expenditure, that the cheapness of continental life lies. Added to this is the pre-eminently practical tone of the French mind, which is always stirring with incessant activity to solve the problem, how to make the best of life.

French town life is very different in many respects from life in the country. It is full of a lazy, purposeless enjoyment, which is always ready with some trifling amusement to fill up every vacant moment in the abundant leisure of men who are either independent in fortune, or have professions yielding them an easy maintenance without engrossing much of their time. To such individuals the cafés and clubs of a small town, with their good eating and drinking and sociable small talk, form a realization of contented felicity beyond which they do not care to aspire, although it stifles all that is noblest in their nature, and too often lays the foundation of what we should call drinking habits.

Minerals.—The chief coal and iron districts of France were situated in the territory ceded to Germany after the war of 1870–71, but her wealth in this respect is still very great. Argentiferous galena, copper, lead, a little silver and gold, manganese, antimony, and tin occur, but hitherto their working has not proved very productive. The neighbourhood of the capital supplies the gypsum better known as "plaster of Paris." Admirable building stone has long been quarried at Caen in Normandy; and extensive slate quarries are situated near Cherbourg and St. Lo; basalt and lava for pavements are supplied by the mountains of Auvergne. Marble is found in many parts, and alabaster in the Pyrenees. Fossil, or rock-salt, is obtained from the Jura mountains; and salt, by means of evaporation, from the lagoons and swamps near Rochelle and the Gulf of Lyons. Mineral springs of various kinds are extremely numerous, of which nearly 1000 are in use, mostly in the Pyrenees, while numbers have not yet been employed for purposes of health.

Money, Weights, and Measures.—The money, weights, and measures of France, and the British equivalents, are:—

MONEY.

The Franc, ...	Average rate of exchange, 25 to £1 sterling.

WEIGHTS AND MEASURES.

The Gramme, ...	=	15·432 grains troy.
" Kilogramme, ...	=	2·20 lbs. avoirdupois.
" Quintal Métrique, ...	=	220 " "
" Tonneau, ...	=	2200 " "
" Litre, Liquid Measure, . .	=	0·22 imperial gallon.

WEIGHTS AND MEASURES.

The Hectolitre { Liq. Measure,	=	22 imperial gallons.
The Hectolitre { Dry Measure,	=	2·75 imperial bushels.
Mètre, ...	=	3·28 feet or 39·37 ins.
Kilomètre, ...	=	1093 yards.
Mètre Cube, } Stère, }	=	35·31 cubic feet.
Hectare, ...	=	2·47 acres.
Kilomètre Carré, ...	=	0·386 square mile. (2·59 kil. carrés = 1 sq. mile.)

Commerce.—The commerce of France has wonderfully increased during the last twenty years, as will be seen from the following table:—

Year.	Imports.	Exports.
	£	£
1865	105,672,240	123,585,000
1870	111,259,720	112,093,960
1875	146,891,450	160,886,480
1880	201,326,680	138,715,560
1881	194,536,820	142,460,000
1882	192,872,000	149,760,000

The value of silk manufactures forms about one-fifth of the total exports of French produce. Woollen manufactures and wine are the next in importance. The export of grain is very variable. The increase in the value of wine exported in the year 1868, as compared with the exports in 1847, was very large, being £12,000,000 sterling against £2,000,000. The mean annual production of wine in France is 1,390,000,000 gallons.

The principal articles imported are raw cotton, silk, wool, and coals. The following is the order of the countries with which she has the largest trade:—Great Britain, Belgium, Switzerland, Italy, Germany, Turkey, United States, Spain, Russia, and Brazil.

The commerce between France and the United Kingdom has very rapidly increased since the conclusion of the Cobden treaty in 1860, as will be seen from the following table:—

Year.	Imports from France into the United Kingdom.	Exports from the United Kingdom to France.
	£	£
1860	17,774,037	12,701,872
1865	31,625,231	25,355,072
1870	37,607,514	21,982,999
1875	46,828,574	27,292,455
1880	41,970,298	27,990,959
1883	38,636,022	29,409,835

The chief articles imported from France into the United Kingdom are:—Butter, wheat, barley, flour, eggs, potatoes, gloves, raw silk, silk and woollen manufactures, brandy, sugar, and wine. The chief exports to France are:—Coals, machinery, iron, copper, silk twist, woollen goods, cotton manufactures, raw cotton, raw silk, and wool.

Internal Communication.—The means of internal communication in France are inferior to those of Great Britain. The roads are divisible into those maintained by the government, and designated *routes gouvernementales*, and those which are kept up at the cost of the several departments to which they belong, and called *routes départmentales*. Besides these there are *chemins vicinaux*, or by-roads. There are 230 governmental roads, extending over 22,000 miles; 265,000 departmental roads, 74,000 miles; and more than 2000 bridges.

About one-eleventh of the 22,000 miles of national roads is paved, and the rest macadamized or constructed in the ordinary manner. They are commonly well made and very direct, being under the superintendence of the central board of bridges and public ways.

The inland water communication is carried on by means of the great rivers, and by the canals which have been formed. Many of the rivers have been improved for navigation, and the artificial canals are rather numerous. The Canal du Midi unites the Garonne with the Mediterranean; the Canal du Centre, the Loire and the Rhone; the Canal du Rhone au Rhin connects the two rivers, as does the Canal de Bourgogne the Rhone and the Seine.

The incompleteness and deficiency of French railway accommodation has also been made inconveniently apparent of late years, and in 1878 M. de Freycinet, the minister of finance, proposed a bold scheme to meet the deficiency of internal communication and effect various much needed improvements in the national harbours. This was the expenditure of the enormous sum of £240,000,000 on public works during a period of twelve years. Of this sum £140,000,000 was assigned for railways, £40,000,000 for navigable ways, and £20,000,000 for ports; the other £40,000,000 being for contingencies. The boldness of such a scheme can only be appreciated by calling to mind the heavy claims which France had to meet in the years succeeding the war of 1870-71, but it was almost unanimously adopted by both Chambers. As we have, however, previously stated, the drain on the government proved too great, and in 1883 the construction of the new railways was undertaken by the existing companies.

The earliest permission of the government to construct a line was given in 1823, but it was not till 1830 that railways were used for passengers as well as merchandise. For a long time after this period much discussion took place in France as to whether the new lines should be made by private enterprise, as in England, or by the state, as in Belgium. Ultimately a compromise was effected and embodied in the law of 1842, which, in principle, gave the power of construction to private companies, but under a government guarantee, and a condition that the lines thus built should become the property of the state after a certain number of years. This term was originally fixed at fifty-five years from the time the line was made, but it was in 1852 extended to ninety-nine years. The government has always endeavoured to bring about an amalgamation of small and rival lines, and the plan has succeeded so completely that the whole of France is now served almost entirely by six great companies, although there are still a few minor lines for local or special traffic. In 1884 there were altogether about 17,000 miles of railway open in France.

Telegraph and Postal Service.—The first electric telegraph in France was constructed in 1844, and the country is now intersected by a close network of wires. Except from one part of the city of Paris to another a uniform rate of postage of 2½*d.* has been fixed for France and Algiers, independently of distance. The telegraphic charge is 5*d.* for every ten words, but this includes names and addresses.

Colonies.—The colonies and foreign dependencies of France are:—1. In America, the islands of Martinique, Guadaloupe, Marie-Galante, Deeirade, Saintes, a part of St. Martin in the Antilles, French Guiana and Cayenne; St. Pierre and Miquelon, near Newfoundland, at the mouth of the St. Lawrence; forming a total area of 124,000 square miles, with 400,000 inhabitants. 2. In Africa, Algeria, Senegal, and Goree on the west coast, and the islands of Réunion and St. Marie in the Indian Ocean, certain portions of Madagascar, and, since 1843, the islands of Mayotta and Nossi-Bé. In 1843 France also took possession of Assinie on the west of the Gold Coast of Guinea. The total possessions in Africa (exclusive of Algeria and Tunis) cover an area of 270,000 square miles, with a population of 580,000 souls. Tunis has been virtually annexed to France since 1881. [See TUNIS.] 3. In Asia, Pondicherry and Karikal on the Coromandel Coast, Mahé on the coast of Malabar, Yanaon in Orissa, and Chandernagore in Bengal. In 1860 the allied French and Spanish troops captured the city of Saigon, in Cochin-China, containing about 100,000 inhabitants, and by a treaty of 1884 the whole of Tonquin was placed under the protection of France. This territory is estimated as having an area of 170,000 square miles and a population of about 5,000,000. 4. In the Pacific Ocean, the two groups of the Marquesas and Tahiti, taken possession of in 1841, and the Island of New Caledonia in 1854, the whole forming an area of 9560 square miles, with 9946 inhabitants. The colonies are subject to special laws. In 1845 an ordonnance was passed having for its object the amelioration of slavery in the French colonies, and in 1848 the provisional government decreed its total abolition.

More important from a political, as well as a commercial point of view, than all the other colonies of France, is that of ALGERIA. The French troops in that colony consist of one corps d'armée, numbering about 60,000 men. They are divided into two classes—namely, the French corps, which remain there in garrison for a certain number of years and then return to France; and the so-called native troops, which never quit the colony except for fighting purposes. In the latter corps, however, there are a great number of Europeans. They consist of three regiments of Zouaves, three of Turcos or Tirailleurs Algériens, three of Chasseurs d'Afrique, and three of Spahis—altogether 15,000 infantry and 3000 horse. Besides these there are the punishment battalions, popularly known as the battalions of Zephyrs.

The French expenditure in Algeria, from its conquest to the end of 1884, has been nearly £250,000,000. It is generally admitted that this outlay has produced no satisfactory results, and that Algeria, commercially and politically, has proved a failure. The only advantage in maintaining it as a colony was for many years supposed to be the valuable training field it provided for the French army, but the experiences of 1870-71 showed that this training had been of little use so far as European warfare was concerned.

History of France.—The Celtic inhabitants of the country we now call France were closely akin, at all events as regards the northern part of the country, to those which at the commencement of our era occupied Britain. In the articles BRITAIN, DRUIDS, GAUL, &c., will be found such knowledge of them as remains to us, derived from the noble work of Cæsar and from later writers. Who possessed the land before the Celts we know not. Prehistoric remains show us only the flint and bone implements of these unknown dwellers in the land. Some of the latter are engraved with rude drawings such as the Indians use to this day to serve as letters or communications to one another of the approach of a friend, or the number and nearness of an enemy. The north-western corner of the Mediterranean became known to the early Greeks following those pioneers of navigation, the Phœnicians; and as early as 600 B.C. the town of Massalia (called, centuries later, by the Romans Massilia, and known to us as Marseilles) was founded by the people of Phocæa, a Greek colony in Asia Minor, driven out by the pressure of the Persians. The colony of Massalia flourished, and became the chief trading port in that part of the world. Sister colonies soon sprung up, such as Antipolis (Antibes), Nicæa (Nice), &c., all due to the enterprise of Greek merchants. The Greeks found a people along these coasts whom they called Ligurians, a dark-haired, round-headed race; and they named the whole land Keltika and its inhabitants Keltoi (Celts), words which became corrupted into Galatia (later Gallia) and Galloi (Gauls) as time went on. The aboriginal inhabitants of Spain (Iberians, *i.e.* dwellers by the Iberus or Ebro) about this time crossing the Pyrenees conquered the extreme west of the land of the Ligurians; and their descendants exist there to this day in the countries of Navarre and Biscay, their language,

their physical type, and their ultimate origin a puzzle hitherto unsolved. After this Iberian invasion the people whom we call Celts, fair-haired, long-headed, blue-eyed, reached Gaul in their westward journey from Asia, and one branch of them, the Gaels (akin to our Highlanders), took the greater part of the country, with all the region of the middle, while the other division, the Cymry (akin to our Welsh, and coming some time after the Gaels), took the northern parts, the Netherlands, &c. We have now reached the state of things which existed in Cæsar's day, several centuries later; the Belgæ (Cymry) in the north, the Gauls (Gael) in the main regions, and the Aquitani (a mixture of Iberians, Ligurians, and Gauls) in the south—the Belgians and the Gauls being, as Cæsar justly remarks, two divisions of one nation. But the Gauls had not been content to stay in their new home. They had early conquered the neighbouring islands, the Gael overrunning northern Scotland and Ireland, and the Cymry Britain. Then they attacked the Iberians and Ligurians of the south, and partly by intermixture with them, partly by conquest, converted them also into a sort of Gauls. Biscay probably always remained free amidst its mountain fastnesses of nature's formation. Next proceeding across the Alps the Gauls descended upon Italy, and occupied all that part we now call Lombardy. Though the Romans gradually brought this territory under submission, it was so essentially Celtic or Gaulish in its population that it was always called by them Gallia down to as far south as the little river Rubicon. There was therefore a large Italian Gallia—a *Gallia Cisalpina* (Gaul this side the Alps) as well as Gallia proper or *Gallia Transalpina* (Gaul that side the Alps), during the Roman power. But these same Gauls under their Brennus, or military leader, attacked the westward peninsula of Greece as well as the central one of Italy, and overrunning a great part of the country they descended on Asia Minor, in B.C. 277, in such numbers as to found a new Gaul or *Galatia* in the heart of the land, which retains its name to this day [see BRENNUS]. They conquered the whole of Gaul proper as thoroughly, and made it as absolutely Celtic as the English made Britain later on Teutonic. The English conquest was an annihilation of the Britons themselves, but the Gallic conquest only annihilated the language and customs of the aboriginal inhabitants; and now in the revenges of time we see the original round-headed, black-haired Ligurian race known to the first Greek settlers asserting its vitality so completely and spreading northwards so insidiously that till recently the popular conception of our day of the Celtic physiognomy was of this essentially anti-Celtic type. The Celts are slowly and surely losing their physical features. Frenchmen of to-day are still at bottom Celtic in temperament, but as to form and figure the researches of Belloguet, &c., conclusively show that they are derived from race-characteristics still older than the Celtic, presumably what we have called Ligurian. The early history of Rome is full of the fair-haired ruddy Gauls (true Celts). The fierce race was a perpetual terror to the Romans, and Rome itself was sometimes in their hands. But in the end as the barbarians grew more settled, and as the Romans grew civilized and organized, the tide turned and the supremacy of order asserted itself. Gallia Cisalpina became, except politically, a part of Italy. Claudius, the emperor, admitted many educated Gaulish nobles to the senate. In the article FRENCH LANGUAGE a proof of the swift and complete Romanization of Gaul is given. Augustus drove great roads through the land, with Lyons for a centre; the Emperor Caius extended Roman citizenship to Gaul. Claudius never forgot that his own birthplace was his favourite Lyons, and other emperors were equally favourable to the improvement of the great dependency. The vine and olive, so characteristic of southern France, were of Roman introduction. When the empire became Christian the conversion of Gaul also followed rapidly; and thus all its national peculiarities, even to its religion, having been abandoned in favour of their imitation of the Romans, the race lost its vitality and sank into decay; and when the Roman power fell, Gaul fell with it, before newer and bolder races of invaders. The Franks, Burgundians, and Lygians ravaged the country, and the Saxons descended upon the coasts. A revolt of the Bagaudæ, probably Gaulish peasants, was at one time a source of ruin. The utmost efforts of emperors, such as Probus (275), Maximian (287), Julian (355), and Valentinian (364), &c., could scarcely keep out the Teutonic hordes.

Of these the Franks (free men) on the northern frontier were among the fiercest and bravest. As early as 293 Constantius, father of Constantine the Great, had been compelled, although he nominally conquered them, to grant them a settlement in Northern Gaul. They, like all the Teutonic hosts, were tribes of equal men, acknowledging their leaders as a matter of discipline, not of right, and despising Christianity in favour of wild lawless gods of their own.

On the last day of the year 406 the Rhine was crossed by a host of these barbarians, who never repassed that frontier stream. They consisted of Vandals, Alans, Suevians, Burgundians, and other Teutonic nations; and although they were kept in check for a time, they succeeded in establishing themselves in various parts of Gaul. The Franks already settled assisted the Roman emperors against the invading tribes; and when this assistance failed in being effectual the barbarians seized their new country and quickly settled down, so that the whole joined interests against Attila when he brought his Huns against Gaul in 451.

Merwing Dynasty.—It was not until the reign of Clovis, about A.D. 481, that the Franks assumed a commanding position. Chlodwig or Hlodowig (Clovis)—whence both *Ludwig*, German, and *Louis*, French—first conquered the Roman portion of Gallia, and then portions belonging to minor tribes; and his sway by degrees extended from the banks of the Lower Rhine to the Loire, the Rhône, and the ocean, including all except small districts held by the Burgundians, the Visigoths, and the Ostrogoths. Chlodwig, as well as all the noblest of the Franks, professed to be descended from a mythical ancestor, Merwing, and the dynasty he founded is therefore called the Merovingian. His conquest of Gaul was immensely assisted by his conversion to Christianity, a change which he also enforced upon his followers. These were the Salian Franks, and the Salian or SALIC LAW of the fifth century has fortunately in great part been preserved. It is of the very highest interest.

But between the first invasion of the Franks in 293 and their conquest of Gaul under Chlodwig a great change had come over the nation. Royalty was now a settled institution; and from the royal gifts to faithful servants of parts of the newly conquered land, gifts coupled with the obligation of service in future, arose little by little the feudal system. On the death of Chlodwig, in 511, his kingdom was divided among his four sons, Theodoric, Clodomir, Clothair, and Childebert (Theodorik, Hlodomir, Hlotachar, and Hildebert); but in a few years afterwards the whole was again united under Clothair, together with additional provinces taken from the Burgundians and the Ostrogoths.

The country, hardly to be distinguished from a part of barbarian Germany just at this time, soon began again to assert its original and fundamental distinction. The parts to the west, nearly what we call France, gradually became consolidated as Neustria, and here some 12,000 Teutons ruled over perhaps 5,000,000 or 6,000,000 Gauls; while the parts to the east took the name of Austrasia, and remained more purely German. Between these and to the south, embracing all the Rhone country, much of Provence,

Savoy, &c., lay Burgundy. At Clothair's death his four sons repeated the fourfold partition of their grandfather, and on one of them dying the land fell permanently into the three great kingdoms above indicated, the shares of two sons going to make up one strong Neustria. The close of the sixth century rings with the discords of two remarkable women: Brunhild or Brunohnnt, who was regent for the youthful kings of Austrasia and of Burgundy, her grandsons, and Fredegonde, first mistress and then wife of Chilperic (Hilporik), king of Neustria, and after Chilperic's death regent of Neustria for his son, the youthful Clothair II. The shrieks of these wrathful women, the murders they caused, and the crimes they committed fill the scanty legende of the time till death has sealed the lips of Fredegonde and permitted her rival of Austrasia to grasp at the regency of Neustria also, and so at the universal Frank dominion. But a danger threatened the fierce old queen. In her own country, Austrasia, she had enraged the nobles by her success in despotic government. Almost at the very moment that all the great Frank power passed into her hands she was struck down by Pippin (Pepin) and Bishop Arnulf at the head of the Frank Austrasian nobles, and young Clothair of Neustria was the second of his name who was king of the united Franks. This brutal youth caused his cousin-kings to be slaughtered, and Brunhild herself met her death by his orders under circumstances of the most sickening cruelty.

But already the race of Chlodwig was enfeebled. The headship of authority passed into a state of permanent regency. First came these two great rival queens-regent, and following them a long series of principal officers of state, who bore the title of *Maire du palais*, mayor of the palace. On the death of Brunhild and the discovery of the feebleness of Clothair II., the mayors of the palace, deriving their authority not by royal favour, but by free election from among the chief nobles, rose to practically kingly authority. The nominal king became little more than a lay figure. The first half of the present century saw a very similar state of things in the empire of Japan. Whether by natural decay of race, or by careful and enervating neglect on the part of their gaolers (for they were almost prisoners at the last), the unfortunate monarchs lost all the respect or affection of their nominal subjects, and sank into the condition of *Rois fainéants* (Do-nothing kings). They were now and then dragged out of the cloister to figure on the time-honoured Frankish bullock-car, their long hair falling on their shoulders, in some pageant of state or on some such occasion, only to be sent back to their seclusion when all was over. Meanwhile the mayors of Neustria and Austrasia, which again became separate kingdoms, fought bitterly for supremacy. Eventually the great family of the Karlings, an ancient German race, came to the front in Austrasia. Pippin of Herstall, a Karling, grandson of the Pippin who overthrew Brunhild, was mayor of the palace in Austrasia. Neustria was shattered as an independent state in his brilliant campaign of 687. Pippin of Herstall wielded the supreme power as mayor of the palace till his death in 714. A brief period of anarchy was followed by the rise to power as Duke of the Franks of Charles Martel—Hammer (*Martel*), that is, of the Moors, for he smote them as with a hammer at Poitiers in 732. Charles was an illegitimate son of Pippin of Herstall. He was probably the greatest captain of his time, and his victory of Poitiers undoubtedly alone saved western Europe from the fate of Greece and of Spain, and thus from centuries of ruin under the Mohammedan superstition. At this time the Franks had but little power south of the Loire; Aquitaine and Burgundy belonged to other kings. Pepin le Bref (the Short), the son of Charles the Hammer, resolved to put an end to the melancholy farce of the nominal sovereignty of the Merwings. Therefore in 752 the last Merovingian king (Childeric III.) was deposed, and as he died soon after, leaving no children, his race died with him. The Merwings had reigned from the victory over the Gauls of Chlodwig in 486 to Childeric's deposition in 752, in all 266 years; but during nearly half this time there was a merely nominal sovereignty. The following is a list of the Merwing kings:—

Merwing Dynasty.—Chlodwig, 481; Theodoric (Metz), Clodomir (Orleans), Clothair (Soissons), Childebert (Paris), sons, 511; Clothair I., sole king, 558; Charibert (Paris), Gontram (Orleans), Sigebert (Metz), Chilperic (Soissons), sons, 561; Clothair II., son of Chilperic, sole king, 613; Dagobert, son, 628; Sigebert (Austrasia), Chlodwig II. (Neustria), sons, 638; Clothair III., son of Chlodwig (Neustria), 656; Childeric II., son of Sigebert (Austrasia), 660; Theodoric III., brother of Clothair (Neustria), 670; Dagobert II., son of Childeric (Austrasia), 674; Chlodwig III., son of Theodoric III., sole king under Pippin of Herstall, 691; Childebert III., brother, 695; Dagobert III., son, 711; Chilperic II., brother, 715; Theodoric IV., son of Dagobert III., 720; interregnum, 737; Childeric III., son of Chilperic II., 741; deposed, 752.

The Karling dynasty began with Pippin the Short, son of Charles the Hammer, who was rather an astute statesman than a great warrior. Allying himself strongly with the church, he got the sanction of the pope to the overthrow of the old Do-nothing dynasty (*Rois fainéants*), and in 752 was crowned by St. Boniface, that "apostle of Germany" whom our own Devonshire had the honour of producing to the world. The princely reward which Pippin gratefully gave the pope in return is recounted in the article DONATION. The new King of France attacked his southern neighbours, the Aquitanians, vigorously, with a view to reuniting the scattered parts of old Gaul, but could not make any settled conquest. At his death in 768 his sons Charles and Carlman succeeded him, and when Carlman died Charles (Karl) became sole king of the Franks, and soon came to be known as Charles the Great. It must not be forgotten that these Frank kings were Germans, not Frenchmen, and least of all Gauls. French, that is, the development of popular Latin (whose proper term is perhaps the Romance language), was a foreign tongue to Charles, as also to several of his successors. He set himself to learn it with that wonderful determination which marked all he did, but he never succeeded in attaining fluency in it. He should indeed be called Karl der Grosse, but so many centuries of Frenchmen have endeavoured to claim him as one of themselves by the name of Charlemagne, that it is now hopeless to rectify the misnomer, although it is a fruitful parent of error. Charles veritably deserved his title of the Great. He fixed his seat of empire at Aix-la-Chapelle, a significant act. His first task was to do that which his father had failed in, subdue Aquitaine, and he added northern Spain to the conquest also. Setting his son Ludwig (Louis) over these southern provinces as nominal boy-king, he next brought Lombardy into submission, and over that he set his son Pepin. Then he conquered Germany and the Saxons, and towards the close of his life the Bretons of the extreme west of France. [See the Map in Vol. v., "Europe under the Empire of Charlemagne."]

The vast empire thus gained needed ceaseless defence. The word empire naturally occurs as the proper description of a sovereignty almost equalling that of ancient Rome; and the title of "Emperor of the Holy Roman Empire" was invented and bestowed upon Charles the Great by Leo III. in Rome in 800, on the occasion of the pope's restoration to his revolted subjects by the faithful emperor. Charles also confirmed and added to the Donation of Pippin. Ludwig or Louis the Pious followed Charles the Great in the empire in 814. His gentle nature unhappily lacked firmer qualities: he would have made an excellent priest, but made a poor emperor. His sons, Lothar (Hlothar) and Ludwig,

and Charles, his son by his second wife (the fearless and ambitious Judith), were in perpetual strife with him and with each other; and after his death they fought together that bloody fight of Fontanet, near Troyes, which practically blotted out the mass of the Frank nation. The chiefs and serfs remained, the men-at-arms had nearly all perished. Lothar fled, and Charles the Bald and Ludwig the German, victorious, divided the spoil of empire. They swore to each other the famous oaths of Strasburg (842), which form the most ancient monument of the French language. From this time Franks and Gauls form one nation with one language—we have almost arrived at France, at least as regards the common folk; the rulers are still Frank, however. Ludwig the German took Germany, Charles the Bald took France. Lothar was too powerful still, though defeated, to be quite disregarded, and he therefore received, in addition to his empire of Italy, Burgundy and a strip between the two Frank kingdoms, which after him (or to be exact, after his successor of the same name) was called Lotharingia. Hence the German name Lothringen, and the French Lorraine for this part of France. [See the Map in Vol. v. of "Europe at the Dismemberment of the Empire of Charlemagne."]

Charles the Bald, instead of frankly accepting his position of king of the Franks, hankered after German possessions and the imperial title. In 875 his ambition in the latter respect was gratified, but he retained his perilous honour only two years. He vainly endeavoured to thrust his brother's sons from the German throne, and to renew under his own sceptre the Frank empire of Charles the Great. The attempt cost much blood and treasure, but perhaps it was worth what it cost if only for producing the Magna Carta of France, the great capitulary wherein the emperor, to attach the nobles to his cause, gave consent to hereditary tenure of land and title. The son of Charles the Bald, Louis II. (the Stammerer), succeeded him in 877. Louis died in two years, leaving his sons, Louis III. and Carlman, to reign successively a short time. By their early death their brother Charles, a boy of five years old (Charles the Simple), became heir to the throne. The German emperor, Charles the Fat (son of Ludwig the German), was invited to become king of France, as the country was in need of a hand stronger than that of a mere child; for it was at this time that the daring Norsemen sailed up the Seine, under the terrible Rolf the Ganger (Hrolf), to Paris itself.

These Norsemen were the brethren of those fierce vikings who at the same epoch devastated the shores of England. They already caused much mischief under Charles the Bald, but actually seized from the incapable hands of Charles the Fat the fair province of Normandy, and thence pushed their ravaging expeditions further and further inland. But just as under the Merwings the mayors of the palace wielded the authority falling from their incapable hands, so also the Karlings were seconded by a race of heroes. These were the counts of Paris, who became also dukes of France. They began with Count Robert the Strong, the only bulwark of defence against the invaders under Charles the Bald. Eudes or Odo, count of Paris, the equally valorous son of the brave Count Robert, and his friend the courageous Bishop Gozelin, surpassed themselves in their desperate resolve to free their country from the Norse pirates. The Emperor Charles the Fat aided them with the presence of a German army, on whose approach Rolf drew off his Norsemen into Normandy, not without severe loss from the good burghers of Paris, however, who sallied forth to deal him a parting blow. The incapacity of the emperor who thus allowed his fairest province to be wrested from him and the heart of his kingdom to be struck at was now so evident, that even his high descent protected him no longer, and he was deposed at the diet of Tribur in 888. He died in some degree of indigence, quite deserted by his former followers. The same year Count Eudes was unanimously elected king, the young Karling Charles the Simple, now eight years old, being again passed over. But his cause found defenders, and Eudes had to fight against the friends of Charles on the one hand and the Norse invaders on the other. In 898 the death of Eudes left Charles the Simple undisputed king. He is called Charles III., the reign of the Emperor Charles the Fat being regarded by the elder historians as an usurpation. The new king thought to quiet the Norsemen by formally yielding them as a fief the territory actually occupied now some years by conquest; and in 912 Rolf was created the first Duke of Normandy, swore fealty, became a Christian, took the name of Robert at his baptism, and did in fact settle down. Normandy quickly became the best ruled and strongest part of France. At the same time Count Robert, brother of Eudes, the late king, was conciliated by being made Duke of France. It was twenty years before the French again seriously rebelled against their German masters, notwithstanding many outbreaks of tyranny, but this time they made sure work. Duke Robert imprisoned the Karling Charles III. in Laon his capital, and he died in honourable captivity. Rodolf of Burgundy ruled as king by election for a few years, and at his death Duke Robert's son, Hugh the Great, now the chief man in France, sent to England for the son of Charles the Simple, thus nominally restoring the Karlings once more. Louis had been taken for safety with his mother, Edgiva, to his grandfather Edward the Elder of England. Louis from Over-sea (Louis d'Outremer) was acknowledged puppet-king on his arrival in 941; and when he felt firm on his throne he earnestly strove to make his mock dominion real. It was of course a hopeless endeavour against the dukes of France and of Normandy, each by himself far more powerful than his titular sovereign. The actual royal domain at this time was limited to the county of Laon alone. Louis died, probably partly of despair, in 954. His son and his grandson succeeded to the title in turn, and with the latter (Louis V.) the direct line died out (987). The power had long been in the hands of Hugh the Cloaked (Hugh Capet), son of Hugh the Great, and himself Duke of France. (He was Abbot of St. Martin les Tours among other dignities, whence his surname of the Cloaked or Frocked.) Though the last three kings had spoken French, their aims and sympathies were still bent, so far as they dared, towards resuscitation of the German empire. On the other hand the country, now fully imbued with a national spirit, felt that the time of foreign kings had passed. Therefore, instead of searching out the nearest Karling heir (probably the late king's uncle), they boldly determined to elect the great Duke of Paris as their king. France thus came to be ruled by its most powerful noble, by its greatest family, and best of all by a Frenchman. But this view, that the Capets favoured those national tendencies which the Karlings had opposed, is sometimes contested. A powerful, though perhaps hardly convincing, attack is made from this side by M. Luchaire ("Hist. des Institutions des premiers Capétiens, 987–1180," Paris, 1884) in a work which is monumental as to its mass of erudition, and engrossing as to its interest and polished style. Charles of Lorraine, uncle of Louis V., made repeated efforts to raise a rebellion in his favour against King Hugh, but in vain. He was eventually captured, and died in prison. The long probationary period was now over, and France was henceforth rapidly to acquire the strength which eventually made it one of the first nations of the world. But for a long time as yet the king, though now stronger than any one of his great barons, was no match for a powerful combination of them. The course of events, however, is henceforth clear, and being fully detailed in the articles on the separate reigns, a slender outline will indicate their general connection.

The list of Karling sovereigns is as follows:—

Karling Dynasty.—Pippin the Short, son of Charles Martel, elected 752; Charles the Great (Charlemagne), emperor, son, 768; Louis I. (Louis le Débonnaire), emperor, son, 814; Charles II. (the Bald), king and afterwards emperor, son, 840; Louis II. (the Stammerer), son, 877; Louis III. and Carlman, sons, 879; Charles the Fat, nephew of Charles the Bald, emperor, acted as regent for Charles the Simple, 884; Count Endes of Paris, elected king on the deposition of Charles the Fat, 887; Charles III. (the Simple), son of Louis II. and brother of Louis III., also elected sole king on the death of Endes, 898; Rodolf of Burgundy, elected 923, on the deposition of Charles the Simple; Louis IV. (d'Outremer), son of Charles, 936; Lothaire, son, 954; Louis V., son, 986, died 987.

The long list of French kings proper begins with Hugh Capet. But the first reigns are occupied with a fierce struggle for precedence between the houses of France and of Normandy. These first dukes of Normandy were some of the strongest rulers the world has seen, nor were the early Capets wanting in vigour. To Hugh succeeded his son Robert, and to the pious and charitable King Robert his son Henry I. Henry's son, Philip I., was king when William the Bastard honourably redeemed the shame of his birth and acquired the glorious sobriquet of the Great, to be later on replaced, after the battle of Hastings in 1066, by the title by which he is generally now known, the Conqueror. Philip also saw the Norman kingdom of Sicily founded in his reign, and the first Crusade (1096), resulting in the short-lived kingdom of Jerusalem. He succeeded in sowing discord among the sons of William the Conqueror, but not in gaining Normandy thereby, as he intended. His domestic conduct was as false as his political; he was excommunicated for the abduction of the wife of Fulc, count of Anjou (ancestor of Henry II. of England), whom he married, though his queen Bertha still lived. He was suspected of conniving at this infamous queen Bertrade's attempt to poison Louis, son of Queen Bertha, heir to the throne, when he returned from exile in England. Louis VI. (the Fat) recovered from this shocking peril after a dangerous illness, and succeeded his father. At this time the king still actually ruled the duchy of France alone. He reigned over the rest of France, but could not strictly be said to rule it. The country was divided into the royal duchy, with Maine and Anjou and seven great fiefs, each of which included smaller fiefs dependent on itself and not on the crown. Those were the duchy of Normandy, the most powerful, with Brittany and many other territories attached; the duchy of Aquitaine, the largest, with Gascony, Berry, &c.; the duchy of Burgundy; the county of Flanders; the county of Champagne; the county of Toulouse, with Provence, &c.; and the county of Barcelona beyond the Pyrenees. The Count of Anjou rendered homage to the king as duke of France, not as king, the Count of Brittany to the Duke of Normandy, &c. The great lords rendered homage to the king, but in most things were themselves absolute sovereigns over their secondary fiefs. These secondary fiefs had their own equally isolated subfiefs, and beyond these were the single baronies and castles. There was no middle class; nothing existed between the wealthy barons and the wretched serfs, who were bought and sold with the land as if they were clods of the very earth they tilled. The feudal system in France is therefore seen to be constructed on a more artificial plan than that of England, and one provocative of much difficulty and weakness. The great nobles were too nearly equal in power to the king and to each other for the peace of the country.

To Louis VI. (the Fat), whose reign was one continual struggle for existence with the great barons, succeeded his son, Louis VII. This prince, with his wife, Eleanor of Guienne (whom he married solely to acquire Aquitaine for the crown), went on the second Crusade to the Holy Land. Eleanor's conduct was such that Louis divorced her on his return from his inglorious expedition; whereupon, to his mortification, she married Henry, count of Anjou, the heir to the crown of England. The county of Anjou and the vast duchy of Aquitaine, with Maine, Touraine, Poitou, &c., passed into the possession of Henry, who soon became king of England and duke of Normandy. England under Henry II. was a greater continental power than France itself. Indeed it was only by a series of "fortunate misfortunes" that the insularity of England was restored to it. These misfortunes occurred in the time of the next French sovereign, Philip II., son of Louis. Philip was perhaps the most astute prince of his time, and gained various surnames —"the gift of God," "Augustus," &c.—from the people whose ambition he fed. While joining Richard of the Lion Heart, king of England, on a third Crusade he gladly assisted John, Richard's brother, to seize the English crown in his brother's absence, and was probably a consenting party to the famous capture and imprisonment of Richard on his journey home through Germany. Later, when John was recognized as king of England, to the prejudice of his nephew Arthur, Philip Augustus seized on Normandy for Arthur as the rightful duke. The land, from old habit, resisted; but when John, having captured his nephew, put him to death (or was credibly reported to have done so) the Normans began to consider that their position under this hated, cruel, lustful foreigner, who moreover used them merely to help him in his rule of England, was not really so good as it would be under a free submission to France. French Philip was less of a foreigner to Normans than Angevin John. Normandy lay down its arms, and was ever after among the most loyal of the provinces of France. By its acquisition the royal power of France was quadrupled. But greater triumphs lay beyond. The quarrel over investiture, that is, practically the right to nominate the higher clergy, had risen to such fury that Pope Innocent III. deposed John altogether, and intrusted his expulsion to Philip Augustus. The English barons, whose wives John's lust had shamed and whose fortunes his rapacity had ruined, held out warm welcome to the French. It is hardly necessary to say how immediately and how basely John yielded, handing his crown to the legate to receive it back after some days as a vassal of the pope, bound to papal homage. (The popes at this time claimed dominion over all islands.) John's grovelling humiliation saved England from a French invasion. With the army he had gathered he crossed into France in a desperate attempt to recover his lost provinces. By the battle of Bouvines, however, he lost more than ever; and his defeat and ruin fortunately so laid him at the mercy of his barons that he consented to sign Magna Carta, the Great Charter of English liberties. Like most of John's submissions it was only feigned, and the false king took advantage of the first lull of suspicion to enter on a fierce campaign of revenge. So successful was he (for he wanted not in military skill) that the English barons actually consented to elect Philip's son Louis king of England, as the price of French aid against the detested Angevin who ruled them. Prince Louis with ample forces crossed to England, received the submission of all the south-east, except Dover, and occupied London. John, hastening towards him, lost his baggage and much of his force also in crossing the Wash, was seized with a fever, and died at Newark. The barons at once deserted Louis and the French project, and hoping for better days elected John's son, the young Prince Henry, king of England as Henry III. After a brief struggle, wherein Hubert de Burgh at Dover was especially glorious, the French withdrew. The close of the reign of Philip Augustus was marked by the fourth Crusade, with the capture of Zara and of Constantinople, and the elevation of the Latin Empire of the East, under Baldwin of Flanders, as result. The crusaders in fact hardly as much as crossed the Bosphorus. At home the horrible crusade against the

Albigenses as heretics defiled the fair fame of France, though Philip himself seems little personally to blame. Normandy, Maine, Anjou, Touraine, and Poitou now belonged to France as crown fiefs, and in Brittany a relative of the Capets was duke, owing homage to the king. The feudal system was by this time perfected, the army thoroughly ordered, soldiers for the first time regularly engaged for pay, and to provide this pay taxes were now first regularly instituted. Perhaps the best title to glory that Philip has, after all, is the establishment of the University of Paris. With so many honours gained it is not to be wondered at that he was often called Philip the Great.

The son of Philip, once so nearly king of England, descended through his mother from Charles the Great: the lines of the Capets and the Karlings thus at last unite. He reigned, as Louis VIII., for but a short time. His main achievement was the reduction of a great part of the south of France, still properly belonging to the King of England. The son of Louis VIII. also bore the name of Louis. This prince, Louis IX., earned the honour of canonization, so rare among kings. His saintship seems to us rather to be gained at the expense of his royal duties. A parallel exists in our own Edward the Confessor. St. Louis was so universally respected that the English king, Henry III., and his barons referred to him the decision of their differences. St. Louis died of the plague in the second of the two Crusades (fifth and sixth Crusades) which he undertook, both of them most miserable failures. He was more successful at home, preserving by arms the conquests of his father, establishing the *parlement*, or high court of justice (not to be confused with the contemporary foundation of the Parliament of England, which was called to much higher functions than those of a law court, however dignified it might be), organizing the communes or "unions of parishes," and regulating the coinage. There were eighty lords who at this time coined money; St. Louis was not strong enough to annul this right, but he eventually secured that the royal coinage should be everywhere valid, and, as a matter of course, the superior facility of universal exchange it alone offered quickly destroyed the rival mints. By the "pragmatic sanction" also St. Louis fixed for ever the large amount of liberty the French Church enjoyed, and still enjoys, from that papal domination which elsewhere has worked so much evil. Philip III. (the Bold, *le Hardi*) succeeded his father, and by the submission of Tunis was able to return with something of credit from the sixth Crusade. His son Philip IV. (the Fair) was a remarkable monarch. His avarice was phenomenal, comparable perhaps to that of our first Tudor, Henry VII. He looked on while town after town fell in Palestine, till the last of all, St. Jean d'Acre, succumbed, rather than incur the cost of retaining the conquests of his fathers. True, he obtained from the pope a right to tax the clergy towards a new Crusade, but the money, like that extorted from his lay subjects, remained in his coffers. His reign was filled with two great contests against Edward I. of England and Pope Boniface VIII. Edward finally consented to peace, and married Philip's sister, but Boniface continued to fulminate anathemas till the end. Philip caused Clement V. to be elected pope on the death of Boniface, under the promise to degrade the memory of his predecessor, and detained him in France to make sure of its fulfilment. Hence began the long exile of the popes from Rome. They settled at Avignon, which one of the later popes, Clement VI., eventually purchased from Joan of Naples. (The purchase money was never paid.) Avignon, with the county of Venaissin, belonged to the popes till 1791, when the Legislative Assembly of the Revolution annexed them as the department of Vaucluse. There seems good reason to think that it was the avarice only of Philip the Coiner (*le Faux Monnayeur*), as he was called, which already had led him to debase the coin to a perilous extent, and to imprison and rob all the Jews in the kingdom in one day, that caused him to extort from the miserable Clement V. the shameful condemnation and judicial murder of the order of the Knights Templars, all whose vast wealth the king thereupon confiscated. This ignoble affair has left a curse on the name of Philip IV. Domestic miseries and public contempt dogged him to the grave in 1314, whither his unhappy dupe, Clement the pope, quickly followed him. Under Philip Lyons was snatched from the empire, and France now reached along the west bank of the Rhone down to Provence. By marriage and otherwise, La Marche, Angoumois, a part of French Flanders, Navarre, Champagne, and Brie were also joined to France.

Louis X. (called *le Hutin*, an old sobriquet of dishonour) succeeded his father Philip. He was already, by marriage, king of Navarre. He and his two brothers were saturated in vice, their wives were equally debauched (Philip had flayed their lovers alive towards the close of his reign), and their sister was Isabella, the abandoned queen of England, who with her paramour, Mortimer, murdered the wretched Edward II. of England. Louis le Hutin wore out his life of vice by 1316, and his brother Philip V. (*le Long*) succeeded him as regent for his infant nephew John I. The infant soon died, and the Princess Joan, his sister, claimed the throne, but Philip set up as a claim against the succession of his niece that females were excluded from the crown by the SALIC LAW, the ancient code of the Frank tribe, whence the Merwings had come. Though we now know the claim to be an absurd misapprehension, it seemed just at the time, and his succession was allowed. But the event turned against himself, for on his own son dying it was his brother, Charles the Handsome (*le Bel*), who succeeded him, Charles being the third son of Philip IV. Charles had only time to assist his infamous sister, Isabella of England, against her husband, King Edward II., at the price of a considerable part of Languedoc, before he too died, and the people openly rejoiced at the providential extinction (for such they considered it) of so detestable a family as that of Philip IV.

Dynasty of Capet.—Hugh Capet, 987; Robert II. (le Sage), son, 996; Henry I., son, 1031; Philip I. (l'Amoureux), son, 1060; Louis VI. (le Gros), son, 1108; Louis VII. (le Jeune), son, 1137; Philip II. (Auguste), son, 1180; Louis VIII. (Cœur de Lion), son, 1223; Louis IX. (St. Louis), son, 1226; Philip III. (le Hardi), son, 1270; Philip IV. (le Bel), son, 1285; Louis X. (le Hutin), son, 1314; John I., an infant, son, 1316; Philip V. (le Long), uncle, 1316; Charles IV. (le Bel), brother, 1322.

At the accession of the house of Valois by the election of Philip VI., the grandson of Philip III. (le Hardi) and great-grandson of St. Louis, the crown of France, though so greatly enriched by the earlier Capets, had many great rivals, of its own creation in many cases. Such were the Capet houses of Burgundy, of Dreux and Brittany, of Alençon, and of Bourbon, the last two descended, like the house of Valois itself, from St. Louis, though, as to Bourbon, by a younger son. Valois, Maine, and Anjou returned to the crown by Philip VI.; Navarre was severed, being given to his cousin Philip. Many semi-independent princes, not of the royal blood, still existed, as the counts of Flanders, Montmorency, Foix, Armagnac, &c. The last two were the great houses of the south of France. The kings of England, Provence, Navarre, and Majorca, the Duke of Lorraine (a vassal of the emperor), and the pope (for Avignon and the Venaissin) also held large portions of the country between them. Edward III. of England, indeed, claimed all France by right of his mother. Isabella would in England have probably succeeded to her brothers; in France the Salic law was supposed to bar her right. Edward claimed that his birth in the life-time of his

grandfather (Philip IV.) did away with the defect of inheritance. The *parlement* solemnly decided against him, and Philip of Valois was crowned king of France. Besides being heir through Philip III., Philip of Valois had married Joan, the daughter of Louis X., who would have been heiress of the crown had it not been for the Salic law, as above mentioned. Edward of England's exclusion made the third such reference to the Salic law within twelve years; and this law was now clearly established.

The long war began—that fearful conflict which Mr. Green, in his picturesque way ("Short History of the English People"), called the Hundred Years' War. It exhausted both France and England. The battle of Crecy in 1346, the fall of Calais the same year, and the plague in 1348 crushed the unhappy Philip. His son, John II., was yet more unfortunate. He thought to get money easily by improving on the pernicious example of his ancestor Philip IV. He debased the coinage in a manner before unknown, and then instead of seizing the Jews' treasure he seized their debts, (!) and by royal ordinance all those who owed anything to the Jews paid to the king, whose receipt alone was valid. The ruined Jews left the kingdom, all who could; and as all the foreign trade was in their hands the country soon fell into complete misery. The states-general were convoked, and the firm attitude of the *tiers état* would almost lead one to hope that out of this evil might arise the great good of the re-establishment of the ancient political assembly of the free Franks, like that from which the English witna and later the English Parliament had arisen. The opportunity was lost, however, and the outcome of the assembly was the adoption of the hated *gabelle* or tax on salt, so long one of the terrors of the French poor. The general discontent grew, and the tyrannous proceedings of the king led some of the great nobles to feel for the common people. The dauphin invited a few of these to confer with him at Rouen, and John II., with a refined treachery probably peculiar to himself, availed himself of this opportunity to seize and execute them all, save the King of Navarre, whom he flung into prison. The agony of the dishonoured dauphin was intense. The Black Prince of England and the regent of Navarre at once advanced, and their bloody victory of Poitiers placed southern France at their feet. Nearly all the chivalry of France there perished, and King John was dragged to London a prisoner. The Black Prince, then only twenty-six, was very respectful to his royal captive, served him bareheaded, &c.; but meanwhile the English ravaged France, and the states-general were almost at the end of their resources. The Dauphin Charles broke all the oaths he had sworn to the states-general to secure their support as soon as he was freed from their presence, recalled his evil counsellors, and resumed the methods of John II. Thereupon Paris, with blue and red cockades, made of the city colours (afterwards with the white of France to become the famous tricolor), rose and executed the worst of them. The nobles retaliated, and there began a furious civil war between the peasants (with whom were the burghers) and the nobles. This was called (from a brutal proverb of the nobles about "Jacques Bonhomme" being made to pay his *gabelle*) the Jacquerie (1358). It was some time before the infuriated peasants, who committed horrible crimes whenever they got the upper hand, were brought again into submission. Two years later, in 1360, John II. was restored to the afflicted country, in exchange for Guienne, Poitou, Gascony, Calais, &c., and 3,000,000 crowns, Edward III. of England renouncing his claim to the crown of France. This was the treaty of Bretigny. To raise the ransom the wretched peasants were again fleeced mercilessly; yet John gave away to his son Philip the duchy of Burgundy, to which at this moment he succeeded, instead of using it as a means of payment. Finally, the king, utterly broken, thought to make a decent end by joining one of the last Crusades. Hardly had he taken the cross, however, than he learned that his son the Duke of Anjou, left as hostage in England, had escaped, forfeiting his honour. John at once set out for England to make good his son's breach of faith, and died honourably in captivity in 1364, at London. Charles V. (le Sage) succeeded him; and bad as his regency had been, he was able, especially with the help of Du Guesclin, to restore the fortunes of France to a great degree. Both the Black Prince and his father Edward shortly afterwards died, and by a mixture of sagacity and boldness Charles recovered loss after loss, till at the end of 1377 the English had only Calais, Bayonne, and Bordeaux left in France. This troublesome time is that which is so vividly brought before us in the later pages of Froissart. In 1380 Charles was succeeded by his son, Charles VI., a boy of eleven, and the country suffered much from the contests of the great nobles for the regency. The king's uncle, the Duke of Anjou, was named as heir to the crown of Naples by the infamous Queen Joanna, murderess of her husband. She was herself shortly after murdered by her paramour. Raising a French army, Anjou invaded Italy to recover his heritage, and perished there miserably with his army. (This Charles of Anjou, son of John II., must not be confused with the Charles of Anjou, brother of St. Louis, who won the kingdom of Sicily by the battle of Grandello in 1266, and in whose time the terrible SICILIAN VESPERS occurred, 1282. The infamous Joanna was the last successor of this first house of Anjou, which had been reigning in Naples for over a century.) Charles VI. seized the reins of government vigorously on arriving at manhood; but suddenly the king's brain gave way, and the necessary regency fell to the queen his wife, Isabella of Bavaria, an able but dissolute woman, and to his brother, the Duke of Orleans. At this time the most powerful subject of France was the Duke of Burgundy. This duchy had reverted to the crown in 1461, and Philip, son of John II., received it from his father. The new duke married the heiress of Flanders, who brought him, as well as that rich province, Franche Comté, Artois, &c.; and these vast possessions the astute duke found means to still further augment. His son, John the Fearless, now came forward to contest the regency with Orleans and the queen, and began by causing Orleans to be assassinated, and then publicly avowing his crime (1407). The eldest son of the murdered Orleans married the daughter of the powerful Count Bernard d'Armagnac. D'Armagnac immediately raised a party to support the cause of his son-in-law, and there began the terrible civil war of the Armagnacs and Burgundians. Both parties committed the crime of calling upon the English to enter France. Just as the Armagnac faction got the upper hand, Henry V. of England finished his preparations and landed at Harfleur.

Even if Edward III. had had some shadowy sort of claim to the French crown, Henry of the Red Rose had none whatever. His title to the English crown rested, like his father's, merely upon a parliamentary election, and in no way could he justify the challenge on the French crown which he now made. The brilliant campaign of Agincourt at once showed his military power (1415); and returning next year he had France at his mercy, after a brief struggle ending in the stern siege of Rouen. Henry's victory was secured by the support of the Burgundian party—for the dauphin had caused John the Fearless to be entrapped and assassinated, and the new Duke Philip was full of revenge—and consummated by his marriage with the daughter of the poor mad King of France. In our day no one would willingly wed the daughter of a madman, but then such things were not considered. (The lamentable result showed itself in the weakness of Henry VI., and ended in the fearful struggle of the Wars of the Roses.) Henry V. was named Regent of France during

the life of Charles VI., with the succession to the French crown at his death. (Treaty of Troyes, 1420.) But a sudden illness struck him down, and he died in Paris in 1422, leaving his boy of nine months old heir to a long life of miserable struggle in France and in England. The poor mad Charles VI. passed away in a few months afterwards. The almost incredible tale of disaster on disaster which befell the English, and of victory on victory which raised the new king, Charles VII. (the Victorious) from a prince without land, followers, or resources, to the full power of a king of France, before whom his foes were driven out of every town in the country save Calais, is bound up with the fortunes of the heroic Joan of Arc. When the Maid of Orleans was burned at Rouen as a sorceress, to the everlasting disgrace of England, Burgundy was shocked into his senses, and rallied to his king to help to drive out the English, whom he had so long wickedly assisted. Charles the Victorious suffered from the ceaseless intrigues of his son Louis, whom at last he endeavoured to arrest, but Louis fled into Burgundy. From thence he sent out spies, and as the old king thought (rightly or wrongly) poisoners also. He refused nourishment, dreading the villany of his unnatural son, or it may be that food was by order of the latter withheld; be it one way or the other, Charles VII. died practically of starvation in 1461.

The man who now succeeded to the throne (Louis XI.) is known to Englishmen by Sir Walter Scott's marvellous portrait of him in "Quentin Durward," perhaps better than by more sober history. His unrivalled craft, his unscrupulous lying and cheating, his cold-blooded cruelty, coupled with considerable personal cowardice and gross superstition; his use of inferior agents, such as his barber, &c., for great state purposes—are well known to us. Nevertheless all must admit that, if a great villain, he was a great king. By the close of his reign he had practically overthrown the feudal system. Burgundy had fallen, and the bulk of it was united to France; Provence was gained, and all the great fiefs were either absorbed or so weakened as afterwards to be easily conquered. France became a whole, and its king to possess an almost unlimited power. Louis protected the new arts of printing, &c., which arose in his reign, but at the same time he laid the foundations of that absolute authority which under different successors was to cost France so dear.

Charles VIII. succeeded his father in 1483. His elder sister, the lady of Beaujeu, regent, arranged the king's marriage with Anne, heiress of Brittany (though both he and she were nominally married to others), whereby this province, too, became French. Charles found himself the most powerful king in Europe, and as soon as he was old enough to conduct an expedition, set out on his famous expedition to Italy to enforce that claim to the kingdom of Naples which the crafty policy of Louis XI. had gradually built up. The exact claim was upon the will of the late King of Naples; the truth was that Charles relied upon his great force. Already two houses of Anjou had held Naples, and ever since the time of Charles the Great Italy had been looked upon as a natural prey of France. Charles had the most extraordinary success in the south, but in a campaign he had to undertake against a northern confederacy of Italian princes he was so roughly handled (at Fornovo) that, though victorious, he was glad to retreat to France (1495). He was preparing a second invasion when he died in 1498.

As he left no direct heir his brother-in-law, the Duke of Orleans, succeeded as Louis XII. The duke was grandson of the brother of the poor mad king Charles (Charles VI.), and had been forced very unwillingly by Louis XI. (grandson of Charles VI. himself) to marry Louis' daughter Jeanne, a princess entirely destitute of personal attractions. Louis XII. desired to be free from her, and desired also to retain Brittany, where the queen-dowager now ruled as sovereign duchess. He therefore procured a divorce from Jeanne of France and married Anne of Brittany, his relative the late king's widow. To coax the infamous Borgia pope (Alexander VI.) to grant the dispensation for this he created his equally infamous son (Cæsar Borgia) Duc de Valentinois. The alliance thus begun led on to other plans. Louis claimed Milan as grandson of the Duchess Valentina Visconti, and invading Italy he conquered the Milanese, with Borgia's countenance. He also imitated Charles VIII. and Charles of Anjou in a third successful French raid on Naples; and he completed the imitation by an equally speedy third retreat from the new conquest. The powerful Ferdinand of Aragon fell upon him just as Pope Alexander died and Cæsar Borgia lay dangerously ill (1504). A few years later North Italy revolted from France, and as Pope Julius II. saw fit to break the alliance with Louis (the famous league of Cambrai) and join with Venice and Spain to aid the insurgents, the French king took counsel with the clergy, and it was unanimously resolved that in certain cases it was lawful to make war on the pope, and that this was such a case. For the times this was a remarkable decision. At first all went well; but by 1511 fortune had changed, and it was necessary to evacuate Italy, and to hastily patch up alliances with the enemies pressing France on every side. Louis, now a widower, married Mary the sister of Henry VIII. of England, and engaged to pay England an indemnity of 100,000 crowns for ten years. This induced that king to withdraw his troops, which, by the battle of Spurs (Guinegaste) had just successfully begun their expedition against France. Ferdinand of Aragon was pacified with the promise of marriage for his grandson with one of the French princesses and the cession of the claims on the Milanese and on Naples. Hardly had Louis, who was fifty-three, received his girl-wife of sixteen than he died, leaving the crown of France once again without direct heirs male.

Francis, duke of Angoulême, was the nearest relative of Louis XII., and had fortified his claim to the crown by marrying the king's daughter Claude. Francis I. was descended, like Louis XII., from the Duke of Orleans, brother of Charles VI. In England (Henry VIII.), Spain (Charles V.), and France the royal power was almost at its culmination. The three monarchs were young, chivalrous, and daring. With such elements adventures could not lack. Francis I. at once dashed upon Italy to wipe out the French disgrace, the famous Bayard being among his generals. The victory of Marignan gave him the Milanese (1515). Francis now stood for election to the empire, but Charles of Spain carried off the prize, to his extreme indignation (1516). Each king at once raised claims against parts of his rival's dominions, and each alike looked to the brilliant young King of England as the means of conquest. Francis invited Henry VIII. to the magnificent conference called the Field of the Cloth of Gold (1520). Charles secretly won over Wolsey by the promise of a cardinal's hat. The latter was again the victor, and Henry joined Charles in declaring war on Francis. The latter desperately raised money by the sale of offices, a fatal habit which clung ever after to the French kings till the Revolution. But all his treasure could not repair the loss of the Conetable of Bourbon, driven into the arms of Charles V. by the persecutions of the queen-mother, whom he had enraged by declining to marry her [see BOURBON], and of Bayard, slain in Italy. In vain the king himself headed his armies; he was beaten and captured at Pavia (1525), and sent to Madrid a prisoner. He was not set free by the emperor till he had resigned to him all his Italian claims and the duchy of Burgundy, pardoned the Constable of Bourbon, and promised to marry Charles' sister; and even then he had to leave his two sons as hostages in Spain (1526). It is hardly necessary to say that once in France the king threw aside his oaths, and sought alliances right and loft. Henry

of England, frigotened at the emperor's power, angry moreover at his conduct relative to the divorce, so desired by Henry, from Catharine of Aragon (Charles' aunt), supported Francis with money for a fourth Italian campaign. Except that the king was not made prisoner this was even more disastrous than before. But the emperor, on his side, was crippled by these successive wars, by the invasion of the Turks, and by the risings of the Protestants in the great Reformation recently begun by Luther; and both princes gladly agreed to the "Ladies' Peace," which Francis' mother (Louise of Savoy) and Charles' aunt (Margaret of Austria) arranged together at Cambrai. Francis recovered his sons on payment of a heavy ransom. The religious persecutions which defile the names of Henry VIII. and Charles V. also sully that of Francis. Hundreds of Huguenots were thrown into prison, and several were burnt at the stake in the king's presence. But Calvin, who dedicated his "Institutes of the Christian Religion" to the king, opened the eyes of Francis, who was already much shocked by the scenes at the stake, and he issued an edict of toleration. Yet in 1546 he permitted great cruelties against the Protestants of Vaud. These frequent changes were matched by those in the sphere of politics, where Spanish invasions of France were succeeded by treaties and effusive meetings of the life-long rivals, to give place to fresh hostilities and fresh reconciliations. There seems little doubt but that the Dauphin Francis was poisoned by the contrivance of the emperor, yet the latter recognized his brother, the Duke of Orleans, as heir to Milan after himself. The utter faithlessness of the time is disheartening to witness, and it is with relief that one arrives at the end of it with the death of Francis in 1547. (Henry VIII. died in the same year, Charles V. not till 1558.) Francis I. is called the "father of letters," and certainly his protection of the brilliant, if irreligious, culture of the Renaissance would merit the title. But his degradation of the *parlement*, his illegal taxation by the sale of offices, and the beginning of the public debt by the "perpetual annuities on the Hotel de Ville," and above all the false gallantry which he encouraged, profoundly corrupted his kingdom. From his reign flow many of the miseries of France.

Henry II. succeeded his father, and on his death, in 1557, by an accident at a tournament, his sons Francis II. (who married the Princess Mary of Scotland, afterwards Queen of Scots), Charles IX., and Henry III. successively reigned. The real power lay greatly in the hands of the famous Cathérine de Médicis their mother, wife of Henry II., and niece of the pope Clement VII. (Medici). It was this terrible woman who brought about, in Charles' reign, the religious war, ending in the massacre of St. Bartholomew in Paris, under the fanatical Catholic leader the Duke of Guise—a massacre imitated in other towns of France till not less than 30,000 Huguenots had fallen (1572). Henry III., when he ascended, plunged the court into the most shameful vices; but at least he sought to moderate the religious hatred which raged so fiercely. Guise retorted by superseding the king's authority in founding the "League," to which association he summoned every true Catholic to belong for the support of his faith. The king was forced therefore to put himself at the head of the League; but he bided his time, and in a few years found means to revenge himself upon the duke for his continued open assumption of authority by the assassination of that powerful prince (1587). Assassination is proverbially a two-edged weapon, and few were surprised when the king fell next year by the hand of the Jesuit Clément (1588). With him, to the relief of France, ceased the house of Valois. A list of those princes follows:—

House of Valois.—Philip, count of Valois, grandson of Philip III., and son of a younger brother of Philip IV., ascended as Philip VI., the Fortunate, 1328; John II., the Good, son, 1350; Charles V., the Wise, son, 1364; Charles VI. (grew insane), son, 1380; Charles VII., the Victorious, son, 1422; Louis XI., son, 1461; Charles VIII., son, 1483. Louis, duke of Orleans, great-grandson of Charles V., and grandson of the brother of Charles VI., ascended as Louis XII., the Father of his People, 1498. Francis, duke of Angoulême, great-grandson of another brother of Charles VI., ascended as Francis I., the Father of Letters, 1515; Henry II., son, 1547; Francis II., son, 1559; Charles IX., brother (Cathérine de Médicis, his mother, regent), 1560; Henry III., brother, 1574, assassinated 1589.

Two princes, Henry de Bourbon, prince de Condé, and Henry de Bourbon, king of Navarre, were alike descended from Robert of Clermont, youngest son of St. Louis (Louis IX.) They had fought side by side under Coligny in the first war of the League, and each had seen his father slain by the Catholics. The claim of the King of Navarre was the better, and he it was who founded the long line of Bourbon kings of France as Henry IV. He had married Margaret, sister of the three last kings, and probably this union alone saved his life in the St. Bartholomew massacre. But he had to conquer his crown before he could wear it. By the closing years of the reign of Henry III. eight civil wars had already desolated France. Condé had fallen in the last one. The League, aiming at nothing less than the extermination of Protestantism, had even attacked the king himself, and Henry III. had called Henry of Navarre to his assistance in his extreme peril. When besieging Paris he was assassinated. The League at once nominated the cardinal Charles of Bourbon king; and while the university denounced Henry of Navarre, Pope Sixtus V. excommunicated him, and Philip II. of Spain supplied his enemies with money, demanding the crown for his daughter the Infanta Isabella, niece of the three last kings, the Salic law to be set aside in her favour, and some French nobleman to be chosen by Philip as her husband. But the *parlement* of Paris boldly urged the sanctity of the Salic law before the states-general, convoked to elect a king, and protested against the introduction of any strange house; and at the same time Henry, with the words "Paris is well worth a mass," consented to become Catholic. The people were only too glad to welcome the cessation of discord, and the gates of Paris were thrown open to receive him. The popularity of Henry was enormous, and has lasted till our own day. He hastened to promulgate the famous Edict of Nantes (1598), which granted liberty of religious faith to the Protestants; and it is probable that in his heart the good king did not greatly change his faith. Henry divorced Margaret of Valois, whose married conduct was certainly bad enough (though probably not worse than his own), and married in 1600 Marie de Médicis, niece of the Grand-duke of Tuscany. It was by this second wife that he had Louis XIII. In every way he sought to make the evil times of the Valois forgotten. Bridges were built (the Pont Neuf at Paris still stands), roads made, silkworms and mulberry trees imported in the south, and France sprang with rapid leaps from out the long miseries of civil war to a prosperity hitherto unfelt. "Before I die," said the good old king, "I hope to see every peasant with a chicken for his Sunday's dinner." His close friendship with our "good Queen Bess," and his firm faith in the great qualities of his friend and minister the Duc de Sully, also aided him in many successful enterprises, and his surname of the Great was fairly earned. In the midst of this overflowing love and admiration from his grateful subjects the king, whose strict adherence to Catholicism had long been suspected, was assassinated in his coach by a fanatic named Ravaillac (1610). The kind-hearted king was going to pay a visit to the Duc de Sully, who was unwell. The despair of France cannot be exaggerated. On all hands the cry rose, "We have lost our father!"

With Louis XIII. and his great minister (or, one should rather say, master) Richelieu, modern French history begins. The chivalrous figure of Henry the Great closes the Renaissance. Richelieu aimed at power, and his unrivalled genius raised France to the leading place in Europe, and the monarchy to an uncontrolled and almost despotic supremacy. In the present cursory survey of the great field of French history further details are inadmissible. Each monarch is treated of in detail in the article under his name. To these articles the reader is therefore referred. Louis XIV. (*le Grand Monarque*) succeeded his father in 1643 when only five years of age; his mother, Anne of Austria, and Cardinal Mazarin wielding the supreme power. The extraordinary civil war of the Fronde disturbed the early part of the reign, but as soon as the king was old enough to govern, the country rapidly grew united, and under the wise administration of the great Colbert improved every year in its commerce and manufactures. Unfortunately Louis lent himself to vast schemes of conquest, elsewhere described [see LOUIS XIV.], which though at first successful proved disastrous in their results by the close of his long reign. Among other misfortunes due to this king was the revocation of the Edict of Nantes in 1685, which drove out the Protestants with their silk and woollen manufactures, &c., to neighbouring countries. At the time the splendour of the court and the success of the administration of Louis XIV. blinded men to what we now see was the inevitable ruin of the monarchy. One phrase of his, "L'état c'est moi," is sufficient to condemn his policy. Accordingly when his treasures were exhausted and his own vigour gone disasters began; from 1702 onwards Marlborough and Engène inflicted defeat after defeat upon his armies, and the home affairs of France sank into confusion. The death of Louis XIV. was an occasion of rejoicing. His youthful great-grandson succeeded him as Louis XV. in 1715, the regency being given to the Duke of Orleans, the late king's nephew. "The regency" is proverbial for an extremity of licentiousness probably never greatly surpassed. It was in this miserable time that Law's project of a bank to pay off by its notes the debt of the nation and reimburse itself by the profits, brought the country to the verge of ruin through the insensate speculation it aroused. The personal immorality of Louis XV. marks probably the lowest point ever reached by a king. He was utterly careless about his kingdom, a favourite expression of his being, "It will last my time." The business affairs of the country were left to Cardinal Fleury, to the Marquise de Pompadour (the king's mistress), finally to any one who could get money for the king and his court. When Louis XV. died, worn out by vice, the prosperity of the country had long ceased; and the teachings of Voltaire and of Rousseau, though so different in their tendency, had alike the effect of bringing men to their senses and preparing for that great Revolution which alone was able to clear the polluted air. From the accession of Louis XIII., in 1610, to the death of Louis XV. in 1774, nearly a century and three quarters intervened, and this long time was covered by only three reigns.

State of France before the Revolution.—The population of France previously to the great Revolution was politically divided into three classes, called *états*, or states—the clergy, the nobility, and the commons, or *tiers état*. The nobility of France was exceedingly numerous; for not only all the children of a noble belonged to the class of their father, but that class was continually increased by the creation of new nobles. There were about 4000 offices or places in the country which conferred nobility, the members of which possessed great privileges. The third class of the inhabitants of France comprehended the whole population, except the nobility and clergy, and constituted somewhat more than 97 per cent. of the whole. The *tiers état* were crushed by the burden of a most injudicious taxation, the weight of which pressed almost exclusively on them. This was rendered still more intolerable by the grossest abuses of the manorial jurisdiction. A consequence of all this was the greatest misery among the people, and a deeply-rooted hatred towards the higher classes.

The revenue was derived from direct and indirect taxation. The direct taxation consisted—1st, of a land-tax called *taille*, levied only on the lands belonging to the non-privileged classes; 2nd, the capitation, to which all classes were equally subject; 3rd, a property tax, principally assessed on lands. These taxes were in many respects very oppressive. But the indirect taxes were still more so. They consisted—1st, of customs levied not only on goods imported from abroad, but on those which passed from one part of France to another; 2nd, of the monopoly of snuff and tobacco; and 3rd, the monopoly of salt. This last was a complete fiscal tyranny, both in its nature and in its mode of collection. The oppression caused by this system of taxation was increased by the custom of farming out the indirect taxes, and by the injudicious corn laws.

The revenue extorted from the people by this system of taxation was squandered in the most profligate manner, and no account was ever rendered. Louis XIV. and Louis XV. shamelessly paid their courtesans and favourites out of the public purse. Louis XVI., on whom the storms of popular indignation subsequently fell, was not only personally pure but severely economical.

The royal power, which had at first been limited by the feudal institutions, gradually became absolute. The meeting of the states-general (*états généraux*) had been discontinued since 1614. The offices of state and of justice, all so regulated as to give the people as little voice as possible in the national affairs, were either hereditary or acquired by purchase, the purchaser of course subsequently making good his expense from such profits as he could extort from his office. Hence arose a smothered indignation, which showed itself before the close of the eighteenth century, in the terrible revenge of the great Revolution.

Louis XVI. was the grandson of Louis XV. A good and amiable person, extremely dull and shy, unable to grasp an idea even when it was set before him, he was the worst possible king for the critical times in which he found himself. The want of funds grew so great that the most ordinary expenses of the court could not be defrayed, and it was in desperation, after minister had succeeded minister and the deficit still grew greater, that Calonne determined to call together the chief men of the kingdom to advise with him, a step taken by Henry IV. in a like emergency. The minister's plan was a general taxation without privilege, the nobility and clergy paying as well as the *tiers état*. Events now moved rapidly as follows:—

1787. The Meeting of the Notables, dissolved the same year, after abruptly rejecting Calonne's proposal and driving him into exile. 1789: The states-general, the ancient assembly of the kingdom, consisting of the deputies of the nobles, clergy, and of the *tiers état* or commons, were called together at the urgent request of the *parlement*. The *tiers état* with such deputies of the clergy as chose to join them (none of those of the nobility at first accepted the invitation), soon voted themselves the supreme legislative body, under the title of the National Constituent Assembly. In this year the division of the kingdom into departments was introduced; the Bastille fell; and first the Assembly and then the king removed from Versailles to Paris. 1790: Hereditary nobility and titles of nobility were abolished. All the nobility "emigrated." [See ÉMIGRÉS.] 1791: A new constitution was promulgated by the Assembly: France was declared a limited monarchy. The king attempted to flee from France but was captured at Varennes. The Legislative Assembly met according to the new constitution.

1792. The royal authority was suspended by the Legislative Assembly. After the riot of the 10th of August the

king was thrown into prison, and the nation was invited to elect a National Convention, and determine on the form of the government. The Convention met in September, and proclaimed a republic, and the king was tried for high treason. 1793: Louis XVI. was executed in January, Marie Antoinette in October; the Girondins also in October. The Reign of Terror had begun. The constitution of the republic was completed, but it was determined that the Convention should continue in power till the end of the war. In 1794 the Revolution continued to "eat its own children." The Hebertists were executed in March, the Dantonists in April. Robespierre was now supreme, but in July his turn too came, and with the tyrant's death the worst of the Revolution was over. In 1792 war had been declared on France by the rest of Europe; in this year (1794) the armies of the Republic began to be everywhere victorious, and in 1795 peace was proclaimed.

A new constitution was now substituted for that of 1793, which was found to be impracticable. The executive power was confided to a body of five, called the Directory. Two legislative bodies, the Council of Ancients and the Council of Five Hundred, were constituted. The boy whom royalists called King Louis XVII. (son of Louis XVI.) died.

In 1799 the constitution was remodelled: the Directory was overthrown: consuls for a term of years were appointed —Bonaparte, Siéyes, and Ducos provisionally; then Bonaparte, Cambacérès, and Le Brun; Bonaparte being the First Consul with all the effective power.

In 1802 consuls for life were appointed—Bonaparte, Cambacérès, and Le Brun. Finally in 1804, NAPOLEON assumed the sovereign power as emperor.

During these changes the boundaries of France were continually extending. Between 1789 and the fall of Napoleon in 1814, France obtained sovereign power over vast territories, and practical supremacy over all Europe in addition, except England and Russia. Napoleon made his brothers or his friends kings of Italy, Spain, Holland, Westphalia, Sweden, &c. He presumed to tear up and remake the map as he would—the tale of arrogance is elsewhere told in this work. In 1814 he fell and was exiled to Elba. He escaped in 1815, and fought the wonderful campaign of the "Hundred Days," ending in Waterloo and his second abdication. He died a prisoner at St. Helena in 1821.

In 1814 Louis XVIII., brother of Louis XVI., was restored by the united powers. The charter was granted in 1814 by this king, after the exile of Napoleon to Elba. In 1824 Charles X., brother of Louis XVIII., succeeded him. Ministerial incapacity, general discontent, and excessive priestly influence characterized this reign. Neither Charles nor his brother could be brought to see that the old days of kingship were for ever past, and when Charles X., by a course of proceeding which savoured too much of the old despotism, finally gave occasion for the outbreak which resulted in his expulsion in July, 1830, Louis Philippe, duke of Orleans, accepted the throne on constitutional principles. (He was the son of Egalité d'Orleans, who voted for the death of his cousin Louis XVI.; Egalité was the great-grandson of the infamous Regent d'Orleans of Louis XV.'s reign.) The hereditary peerage was abolished, and various reforms were made, tending to assimilate the government more nearly to that of England. By degrees the confidence of the people in the new king became somewhat shaken, and many severe laws were passed. In 1835 the Duc de Broglie, then prime minister, proposed a series of stringent laws against the liberty of the press and against the independence of trial by jury; and he succeeded in carrying them in spite of all opposition. Prosecutions against political offenders became frequent, and much hostility and heart-burning arose. The king, however, being a man of ability, and having the tact to play off the leading statesmen against each other, succeeded in consolidating his power, though not without repeated incipient insurrections, and many attempts on his life. The war in Algeria; the bringing back of the remains of Napoleon from St. Helena; the various marriages by which Louis Philippe strengthened his family connections; the fortifying of Paris—these formed some of the chief events of the reign. In the latter part of 1846 occurred the events connected with the marriages of the Queen of Spain and her sister. These circumstances led to some estrangement between England and France, which lasted till the downfall of the king.

During 1847 demands for constitutional reforms in France became loud and frequent; but as public meetings for political discussion were prohibited by law, such discussions were transferred to public banquets. These banquets became more numerous as the year advanced, and it became at length customary to omit drinking the king's health. In this year the war in Algeria was closed, by the surrender of Abd-el-Kader. Then came the eventful year 1848. On 10th February, M. Duchâtel declared that the government would not only grant no reform, but would put down the reform banquets. This decided the fate of the king. Articles of impeachment against M. Guizot were brought in in the Chamber of Deputies by M. Odillon Barrot. Conflicts in Paris on the 22nd, 23rd, 24th, and 25th of February took place, and the government was vanquished. The king, the royal family, and M. Guizot took flight; the proposal of a regency under the Duchess of Orleans was rejected, and a provisional government was established. The republic was proclaimed. The monarchy had again fallen.

With Louis Philippe ends the long line of Bourbons, of which the following is a list:—

House of Bourbon.—Henry of Bourbon, king of Navarre, descended from St. Louis, ascended as Henry IV. (the Great) 1589; Louis XIII., son, 1610; Louis XIV. (le Grand Monarque), son, 1643; Louis XV., great-grandson, 1715; Louis XVI., grandson, 1774; Louis XVII., son, nominally king on his father's execution, 1793; Louis XVIII., brother of Louis XVI., nominally king 1795, really restored 1814; Charles X., brother, 1824, deposed 1830, died 1836; "Henry V.," Comte de Chambord, last of his line, grandson, never reigned, died without children 1883. Louis Philippe of Orleans, descendant of Louis XIII., ascended 1830, abdicated 1848, in favour of his grandson, the Comte de Paris, who never reigned.

The Second Republic.—Soon after its formation financial affairs assumed a desperate position; failures occurred all over France, and the operatives, urged on by theorists and by the numerous clubs which had now become established, clamoured for state support. Many conflicts arose out of this question of the state support of workmen. A National Assembly of 900 representatives met on the 4th of May; and soon afterwards an *ad interim* executive government was chosen, composed of Lamartine, Ledru Rollin, Garnier Pagès, Arago, and Marie. This executive government chose a ministry, which was embarrassed by violent proceedings on the part of the working classes. A grant of 3,000,000 francs was made on the 15th of June to the national workshops; but as the government felt the necessity of putting an end to this system, the populace broke out into revolt, which led to considerable carnage.

During the month of September the National Assembly settled the constitution. There was to be a president elected every four years by the universal voice of the nation, and only a single legislative chamber, the members to be elected by ballot and universal suffrage for the period of three years. The number of representatives was to be 750.

At the election of the members of the National Assembly for Paris in April, 1848, Louis Napoleon, nephew of the Emperor Napoleon (being son of Louis, king of Holland), had

been returned as representative of the Seine by the extraordinary number of 119,752 votes. The election of president was fixed for the 10th of December, when he was chosen by nearly 6,000,000 votes. On the 20th of the same month he was duly inaugurated by the National (Constituent) Assembly, and took his oath to the new constitution. A great struggle, however, soon commenced between the different interests which the revolution had raised to importance in the state. The National Assembly did not appear disposed to abdicate its powers. It was, however, dissolved in May following, and the general election plunged the country into a state of great excitement, for of the twenty candidates returned for the department of the Seine ten were socialists. The Legislative Assembly met on the 2nd of June, and the spirit of party became extremely violent. In the meantime Napoleon was acquiring great popularity by his politic measures, and during a tour through the provinces he called forth the most lively enthusiasm. During 1851 contests between the legislative and executive powers frequently occurred, and became more hostile as the period for the end of Louis Napoleon's term of presidency approached. A great and final struggle was inevitable. The government not only contended with the Assembly, but with Generals Changarnier, Cavaignac, and others possessing great political influence. At length the Legislative Assembly, becoming alarmed at the attitude assumed by the prince-president, sought to have an armed force placed at the disposal of its own president; but the motion was rejected by a small majority. An attempt was next made to determine the responsibility of the president and his ministers.

The measures proposed were so hostile to the government that Napoleon determined upon immediate action, and the memorable *coup d'état* of 2nd December was the result. The leading men of the capital, including Generals Changarnier, Cavaignac, Lamoricière, and others, were arrested and the National Assembly dissolved. Troops filled the streets of Paris, firing upon men, women, and children, to strike terror into the people. Even with this it is surprising that few barricades were erected, and nothing like a determined resistance anywhere exhibited itself. The most reprehensible features in these transactions were the arbitrary arrest and deportation of many distinguished personages, whose only crime was political hostility to the president and his government. There can be no justification of Napoleon's treachery, though as extenuation may be urged the utter incapacity exhibited by the various factions of which the National Assembly was constituted, and into which France was divided. On the 31st December, 1851, the people, by more than 7,000,000 votes, decided in favour of the continued maintenance of authority by Louis Napoleon.

In the following November (1852) the question of the re-establishment of the French Empire was submitted to the people, when it appeared that 7,824,189 voted in its favour, and only 253,145 against it. Napoleon being thus almost unanimously elected to the empire, on the 2nd of December made his public entry into Paris, and took up his residence at the Tuileries, under the title of Napoleon III. (Napoleon II. was assumed to have existed in the poor little "King of Rome" who died in exile in Austria, the only child of the first Napoleon.) In 1854 Napoleon III., to whom a military success was indispensable, joined England in a war against Russia, terminated victoriously by the fall of Sebastopol in 1856. In 1859 one short French campaign freed Northern Italy from the Austrian yoke by the victories of Magenta and Solferino. The price for this was the annexation of Nice and Savoy to France. In 1862 Napoleon made the grave mistake of undertaking an expedition to Mexico, in the course of which the Archduke Maximilian of Austria was declared emperor of Mexico. The enterprise was disastrous and cost Maximilian his life in 1864. The emperor never recovered his prestige. A grand International Exhibition (copying the English model of 1851) had been held in 1855, and this was repeated on a much more magnificent scale in 1867. But the nation, though prosperous, was uneasy and ashamed at having been for fifteen years the prey of a group of adventurers. The dissipation of Paris was extreme, and speculation quite unbridled. As a last resource Napoleon determined on another war.

War with Germany and Establishment of another Republic.—While matters had been thus proceeding in France, what at first seemed a comparatively slight incident in a neighbouring country was destined to produce results of the most tremendous character. Spain had been in want of a king for some time, and after a great deal of fruitless negotiation Marshal Prim at last announced that he had got exactly the right man for king, and that this perfect and most unobjectionable candidate was Prince Leopold of Hohenzollern.

Thus quietly and innocently was the match set burning which, in a few days, was to blow Europe into an explosion. The emperor had been so often cajoled and outwitted by Count von Bismarck, the Prussian minister, that this time he was determined either to humiliate Prussia or to go to war. The Duke of Gramont was instructed, without asking explanations, without any recourse to diplomacy, to declare in the Chamber that the German candidate must be withdrawn or war would be the consequence. The Prussian court at first treated the quarrel with indifference, and declared that the Spaniards were free to choose their king where they pleased, and that Germany was not concerned with the choice. But great exertions were made by the neutral powers, and especially by England, to get something done which might reasonably satisfy France. First, the prince's father withdrew his son's name; and then, in the last resort, the king was induced also to withdraw his countenance to the candidature of Prince Leopold. France had got all, and more than all, that she was entitled to demand. But the emperor, after great hesitation, impelled by a small clique of favourites, and possibly anxious as to the sentiments of his large army, a portion of which had just voted against him, determined to make peace impossible, and required that the King of Prussia should engage never again to consent to Prince Leopold being a candidate. There could be but one answer to such a demand, and on 15th July the emperor, amid the enthusiastic acclamations of Paris and the apparent assent of the whole country, except a few Republican and Liberal deputies and partisans, declared the war on which he was bent. Marshal Lebœuf told him that France was perfectly prepared, and M. Rouher congratulated him on the arrival of the moment to which for four years he had been looking forward. Before, however, a shot had been fired, Count von Bismarck complicated his position by suddenly revealing a secret treaty, by which the emperor undertook to let Prussia arrange matters in Germany as she pleased provided France was allowed to seize Belgium. Much angry correspondence followed, but in the end it became quite clear that Count von Bismarck had encouraged plots of the kind, and that the emperor, while supposed to be the trusty ally of England, had secretly meditated to deal her honour and interests a deadly wound.

Day by day passed after war was declared, and nothing was done by France. It was not until the 28th July that the emperor arrived at Metz, and even then there was utter inactivity. The emperor had, in fact, learnt by this time that the whole of his military organization was rotten. There were no adequate supplies, no store of ammunition, and a large portion of his force existed only on paper. He had four corps, under L'Admirault, Frossard, De Failly, and MacMahon, on the eastern frontier, but not near enough

to support each other; he had Douay at Belfort, Canrobert at Châlons, and Bazaine and the Guards at Metz, but he had not the military skill or the military resources necessary to combine the several portions of his army into an effective whole. For the mere sake of seeming to do something he joined Frossard at Saarbrück, poured a few shells into the town, and sent off a ridiculous telegram to the empress to say that his poor little boy had had a baptism of blood, and had picked up spent bullets in a way that made old soldiers shed tears of joy. This was the first and last success he had to chronicle. The tiny affair at Saarbrück took place on the 2nd of August, and on the 3rd the Germans entered French territory. They had had nearly three weeks to collect their forces, and in this time they had got together 500,000; one army, under Prince Frederick Charles, being stationed on the Moselle; one, under General Steinmetz, acting for the king, in front of Saarbrück; and a third, under the Crown Prince, a little further south, on the Lauter. On Thursday, 4th August, the troops of the Crown Prince attacked De Failly at Weissenburg, and although the French, aided by the strength of their position, fought well, they were overpowered by numbers, and had to retreat. MacMahon joined De Failly, and awaited the German attack at Woerth. Saturday the 6th saw two enormous reverses to the French arms. At Woerth they were defeated with such an utter rout that MacMahon had only two regiments unbroken with him when he got to Saverne; and at Forbach, above Saarbrück, Frossard sustained a defeat equally disastrous at the hands of Steinmetz. The emperor saw the vast importance of the defeat of MacMahon, and could only say, in telegraphing the disastrous news to Paris, that 'tout peut se rétablir." During eight days there was a pause in the war, spent by the emperor in hopeless, helpless vacillation, until on the 12th he appointed Bazaine generalissimo, and Bazaine decided to retreat with his large and splendid army to Châlons. But he did not act quickly enough, being greatly embarrassed by the presence of his imperial master, whom he had much difficulty in getting off in safety to Verdun. On Sunday the 14th, although a portion of his troops had begun to move towards Verdun, a large number still rested on the right bank of the Moselle, when they were attacked by Steinmetz and driven under the shelter of the fortifications. This delayed the retreat, and when, on the following Tuesday, the French army had got a few miles out of Metz they found their course barred by the ever-active German cavalry, who were later in the day strengthened by the arrival of a body of infantry, the vanguard of the great German army, which had been sent rapidly by Pont-à-Mousson to intercept Bazaine. The Germans, on this one occasion, had a great numerical inferiority, and suffered terribly; but although they could not defeat the French, they entirely succeeded in their main object: they forced them to pause until the whole German army had come up. Bazaine determined to fight, and on the 18th the great and bloody battle of Gravelotte was fought. When the day came to a close, Bazaine and the great army of the Rhine were imprisoned in the lines of Metz.

When the disasters of Woerth and Forbach became known at Paris, the excitement and indignation of the people were extreme. On the 9th M. Jules Favre proposed that the emperor should be "recalled, as being incapable;" to which M. Granier de Cassagnac replied, that the leaders of the Left ought at once to be tried by court-martial. But the Chamber, although not prepared for extreme measures, determined to change the ministry, and passed a vote of want of confidence in M. Ollivier; who, three weeks after he had declared that he entered on the war with a light heart, was turned out of office on account of the great calamities that war had brought on his country, and slipped away into exile and merited obscurity. General Trochu, who was known as a strong opponent of the government, was called to undertake the organization of the defence of the capital, and a few days afterwards was made governor of Paris. But the empress, who avowed that she was less afraid of the Prussians than the Republicans, would have nothing to do with a popular ministry, and placed at the head of affairs a devoted band of Imperialists under General Montauban, count of Palikao. This precious set of incapables set themselves energetically to two tasks. They invented the most audacious falsehoods, devising one piece of good news after another, in order to bewilder and deceive Paris; and they forced MacMahon and the emperor to break up the camp at Châlons, and set off by a long roundabout to relieve Bazaine. When, on the 24th, the Crown Prince reached Châlons with 150,000 men he found MacMahon gone, and hastened after him. Meantime the Crown Prince of Saxony had been detached with 90,000 men from before Metz on the same errand. The Germans pushed on vigorously, while MacMahon, retarded by the utter inefficiency of all his auxiliary services of war, crept slowly along until he reached the Meuse, in the neighbourhood of Sedan. The Saxon army felt their way along both sides of the river, until on the 30th they surprised De Failly at Beaumont, and utterly routing him drove him across the river. Fighting continued all the 31st, and on the 1st of September the great battle was fought which was to end the Second Empire. For some hours the French seemed to be successful, and the emperor telegraphed to Paris that a victory might be expected; but the Germans were only holding the French in check until, with their greatly superior numbers, they had surrounded them. The French were driven in confusion into Sedan, and the emperor determined, against the entreaties of his officers, to send a flag of truce. A white duster, the only emblem that could be procured, was accordingly raised on a spear, and this rag was despatched to announce that the Emperor of the French, his marshals, his generals, and his soldiers, were ready to capitulate. On the next morning he sought an interview with the King of Prussia, and had Wilhelmshöhe assigned him as the scene of his captivity. De Wimpffen, who had succeeded to the chief command after MacMahon, who had been badly wounded, attempted to obtain terms, but the German commander showed him that he was utterly powerless, and insisted that the surrender must be unconditional. There was no help, and the greatest military catastrophe of modern times was consummated. A whole French army, numbering upwards of 100,000 men, was at one stroke made prisoners of war, and all its materials of war passed into the hands of the enemy.

When the news of this great disaster reached Paris a new government had to be created. On Sunday the 4th Count Palikao went to the Chamber and proposed that it should govern. The ultra-imperialists proposed that Napoleon IV. should ascend the throne; but M. Jules Favre would hear of nothing but a republic, and Paris was of the same mind. The national guard assembled, and marched to impose its will on the Chamber; the troops fraternized; Paris was wild with delight; and before the evening there was a republic, there was a government of National Defence, headed by General Trochu, and composed of Jules Favre, Gambetta, Jules Simon, the veteran Cremieux, and one or two others. The empress with some difficulty and risk escaped from the Tuileries, and sought refuge in England; while the senate, which had vowed to sit quietly awaiting the fate of martyrs, dispersed when it was ascertained that no one was taking the least notice of its heroism. But however bold were the resolves of the new government, nothing could avert the approach of the Germans, and on the 19th September the investment of Paris was completed. Jules Favre a day or two afterwards met Count von Bismarck at Ferrières; but although the representative of France was ready to do

everything else for peace, he would not yield territory; and Count von Bismarck would not bear of peace unless Germany was to get some advantage in her frontier defences in return for all that the war had cost her. Strasburg was more especially demanded, and although Strasburg had been besieged by the Badeners since the 10th of August, it had not fallen, and M. Jules Favre declared himself unable to surrender a French city still in French hands. The negotiations were broken off, and shortly afterwards, on the 27th September, Strasburg surrendered, as Toul, a small fortress on the Nancy Railway, which had long interfered with the German communications, had done four days before. On the 7th October Gambetta left Paris in a balloon, reached Tours, which had now become the seat of government outside Paris, and set earnestly to work to organize an army on the Loire that might relieve Paris. Had he been able to effect his purpose while Metz still detained 180,000 Germans round its lines, he might have accomplished great things; for the Bretons were fast arming in the west, Garibaldi was in the east fighting blindly for the universal republic, and Lyons and Marseilles, although doing little, and importing by their revolutionary excesses much bitterness and division into the struggle, were yet willing to obey the government of Tours. But Bazaine could not, or would not, hold out any longer. He had made, in the beginning of October, a sortie, which was only foiled by the dauntless resistance of the Prussian landwehr; and he had, apparently with the connivance of Count von Bismarck, been trying to arrange that his surrender should be coupled with the restoration of the emperor—a project which fell to the ground on account of its rejection by the empress. On the 27th of October he surrendered unconditionally, and the whole army of the Rhine, 150,000 strong, with a virgin fortress and enormous stores of ammunition, were delivered over to the enemy. The army of Prince Frederick Charles, which had been beleaguering Metz, was thus set free to deal with the French army of the Loire. The honour of France demanded an investigation into so stupendous a surrender, and Marshal Bazaine was in 1873 tried by court-martial; having been adjudged guilty of not having done all that was required by duty and honour, he was condemned to military degradation and death. This was commuted by Marshal MacMahon to twenty years' confinement to a fortress, from which, however, Bazaine escaped in 1874.

Immediately after the fall of Metz, M. Thiers attempted to negotiate an armistice; but the attempt ended in failure as soon as it was known that during the armistice the Germans would not permit Paris to be revictualled. It may have been a mistake from a military point of view in the French not to have accepted an armistice, even on the terms on which the Germans would have granted it; but there was violent opposition both at Paris and Tours to any concession to the enemy. General Trochu thereupon took the sense of Paris by a direct vote, and an overwhelming majority showed that Paris was determined to support him. M. Gambetta, on his side, immediately showed what he had been able to effect by his energetic preparations. The army of the Loire advanced under General D'Aurelles, forced the Bavarians out of Orleans, which Von der Tann had held for a month, defeated them at Coulmiers, and forced them to retreat until their junction with the Duke of Mecklenburg gave them temporary safety. D'Aurelles lost this golden opportunity of advancing on Paris, and remained inactive, owing, it is believed, to want of supplies, until Prince Frederick Charles had come up. Meanwhile the Germans were also operating in the north, and on 28th November Amiens was taken, after a fight which sufficed to show how little the new levies of the north could withstand the German veterans. The advance of the Germans in the south-west was gallantly resisted at Beaune-la-Rollande by Bourbaki, but no decisive advantage was obtained; and the French collected themselves for the great effort of uniting a grand sortie from Paris with an advance of the whole army of the Loire. The sortie was made on the 30th, and was continued on the 2nd of December under General Ducrot, but although it was so far successful that the French at one time established themselves in strength on the left bank of the Marne, and to some extent permanently extended their works, yet they entirely failed, owing to the desperate bravery of the Saxons and Würtembergers, to pierce the lines of the besiegers. They had reckoned on the co-operation of the army of the Loire, but their hopes were baffled by the operations of Prince Frederick Charles, who, on the 2nd December and the two following days, attacked and drove the French out of all their positions in front of Orleans, and entered the city. One half of the army of the Loire was driven over the river, under Bourbaki; the other half retreated under General Chanzy westwards, and fought the troops of the Duke of Mecklenburg day after day, until on the 15th Vendôme was taken, and Chanzy retired on Le Mans. In the north General Manteuffel took Rouen without resistance, and pushed on to Dieppe, but had to retreat in order to stop the progress southwards of Faidherbe with the French army of the north. This he did successfully in a battle fought in the neighbourhood of Amiens, and the French retreated to the shelter of their northern fortresses; while in the Burgundy country General Werder successfully resisted the efforts of the Garibaldians and the franc-tireurs to break through the German line of communications at its base. Before the end of the year Phalsbourg, after a resistance worthy of its old fame, Montmédy, and Thionville were all in the hands of the enemy, while of the besieged fortresses in the provinces Mézières and Belfort alone held out.

When the year 1871 began the prospects of the war in France were almost, but not quite desperate. Mont Avron had just been occupied on the east of Paris, but Werder had been forced to retire from Dijon, and Faidherbe, after winning or losing the battle of Noyelles, had sought shelter under the walls of Lille; while Chanzy was at Le Mans, keeping himself before the world by his indignant protests against the announcements of his enemies that they had beaten him in the protracted struggle of his retreat from Orleans. On the 2nd and 3rd of January Faidherbe tried in vain to force Manteuffel out of Bapaume; and then Von Moltke, by one of the most masterly strokes of his military art, sent off Manteuffel with a considerable portion of the troops acting against Faidherbe to strengthen Werder in the east of France, while a large body of Saxons were hurried northwards from the army besieging Paris to support Von Göben, who commanded the troops left behind by Manteuffel. On the 19th Von Göben, thus strengthened, defeated Faidherbe at St. Quentin, and so the French northern army was disposed of. A week before Chanzy had been utterly routed and driven out of Le Mans by Prince Frederick Charles and the Duke of Mecklenburg, so that all hopes were over from the west; while the bold project of sending Bourbaki to crush Werder in the east was frustrated by the firmness and gallantry with which Werder managed, though attacked by a force nearly four times as strong as his own, to keep the French at bay until Manteuffel came up and drove 80,000 Frenchmen, broken down, starving, and demoralized, over the Swiss border. On the 19th, Paris, which had been for some days bombarded without having received any real injury, made its last hopeless effort, and Generals Ducrot and Vinoy conducted a despairing sortie towards Montretout, which succeeded moderately well until the troops came in reach of the heavy German artillery, when it utterly collapsed. There was no hope from within or from without, and Paris had no choice but to capitulate. On the 24th Jules Favre went to Versailles, and on the 28th he signed an

agreement with Prince Bismarck, by which all the forts and materials were to be given up; the national guard being, however, allowed to retain their arms, in compliance with the earnest supplication of M. Jules Favre, who subsequently begged the pardon of God and man for his folly in asking it. Paris was to pay £8,000,000 sterling at once, and an armistice was to begin, except in the departments where Bourbaki was being delivered over to Manteuffel, in order that a National Assembly might be called to ratify or reject terms of final peace. Gambetta protested violently against these terms, accused his colleagues of withholding intelligence from him, and issued edicts disqualifying for seats in this Assembly all persons who had held office under the empire. This edict was at once countermanded, and Gambetta retired for some time, sick in body and heart, into comparative obscurity.

Directly the capitulation had been signed, vigorous efforts were made to relieve the starving population of Paris. The English government sent off a large quantity of stores. English charity showed its usual promptness to give, in a form that varied the monotony of ordinary alms-giving; and the conquerors supplied rations which they had been accumulating in anticipation of the close of the siege. Paris had enough to eat, and its attention and that of France was concentrated on the elections to the Assembly which was to meet at Bordeaux. On its assembling it was found that Paris and some of the large towns had sent deputies of the extreme republican party, but the rural districts had sent a large body of fierce monarchists; the Orleans princes had been returned by large majorities; and M. Thiers had been marked out as the man to take the lead in the government of France by the extraordinary number of constituencies which had returned him at the top of the poll. The deputies from Alsace and Lorraine, where the Germans had left the elections uncontrolled, made a touching appeal to the Assembly not to desert Frenchmen who still so earnestly longed to be French. But the Assembly had no choice. France wanted peace at any cost, and simply trusted to M. Thiers to get for her the best terms possible. He had made a stout fight at Versailles, but Prince Bismarck, who absolutely declined to listen to any neutral power, knew what he wanted, insisted on it, and got it. Peace was signed on the 24th of February, and ratified on the 28th by a vote of 546 to 107 in the Assembly, which also nominated M. Thiers as chief of the executive, on the understanding that all future questions of policy should be decided, not by him, but by the Assembly. By this treaty France gave up to Germany the fifth part of Lorraine, including Metz and Thionville, and Alsace less Belfort. She undertook to pay five milliards of francs, of which one was to be paid in 1871, and the remaining four by instalments extending over three years, interest at 5 per cent. being paid on so much of the total sum as from time to time might be unpaid. The German army of occupation was to be maintained at the cost of France, and was to be reduced gradually as the indemnity was paid. Hard as these terms were, there was yet another humiliation which France was made to endure: 30,000 Germans were to enter Paris as a symbol of their triumph, M. Thiers having had the option to give up Belfort or consent to this, and having wisely preferred to bear a temporary suffering. The stay of the conquerors was very short, as it was arranged that they should only remain until the ratification of the Assembly became known, and they entered Paris on the 1st of March, to leave it on the 2nd. They at once gave up the forts, except on the northern side, to the French, and General D'Aurelles was ordered to take the command of the national guard, and was to be supported by a portion of the army of the Loire. But these measures for the maintenance of order were never effectually carried out; and before long it was discovered that the authority of M. Thiers and the Assembly, which removed to Versailles, was threatened with a most serious opposition at Paris, and that the capital was to be the scene of a new and more terrible war.

The government of National Defence had, during the siege of Paris, been more than once threatened by the violent and turbulent section of the population, which, under the vague name of the Commune, offered to establish an authority which should at once found a real republic, and carry on the war with new and triumphant vigour against the Germans. After the recapture of Le Bourget, and the announcement of the fall of Metz at the end of the previous October, this section, stimulated by the general indignation and regret, actually made prisoners of the leading members of the government during a few hours, and were only suppressed by the firmness of a portion of the national guard. Again, a few days before the capitulation of Paris, a band of insurgents forced open the prison of Mazas, and attempted to install their chiefs in the *mairie* of Belleville. They were put down partly by the strenuous efforts of General Clément Thomas, and partly by a sharp use of fire-arms on the part of a regiment of mobiles who were guarding the Hôtel de Ville. The terms of the capitulation left the national guard in possession of their arms; and a portion of the force began to collect cannon at Montmartre, on the pretence that they were thus saving them from the Prussians. The city was a prey to the most violent agitations during the first days of March, and it appeared that a central committee of the national guard had been formed, which took on itself to order what the national guard should do. By the middle of the month the force at the disposal of the committee had collected 100 cannon at Montmartre, and had the city at their mercy. The government determined to get hold of these cannon, and early on the 18th of March General Vinoy was sent with a regiment of the line to seize them. The operation was performed with perfect success, when it was discovered that they had no means of removing them. The loss of time was fatal. Day dawned, the populace woke up and mingled with the troops. General Lecomte attempted to recall his men to their duty, and ordered them to fire. But it was of no avail. The insurrection had triumphed, and by midnight every representative of the constituted authority had run away, and Generals Lecomte and Clément Thomas had been murdered in cold blood. Two efforts to turn the tide were made during the following week, but they were of no avail; and by the end of the month the Commune was definitely established, and was presiding over every department of affairs.

The triumph of the Commune placed Paris at the mercy of one of the strangest governments that the world has ever seen. It was composed of a few honest and moderately capable enthusiasts—of whom Jourde, its financial chief, was the brightest example; of the agents of the International, a society formed a few years previously for the impartial subversion of capitalists in every country; of the dregs of Parisian journalism, and of military adventurers from almost every nation except England. It had its own internal quarrels, and one after another of its distrusted military leaders had to change defeat for imprisonment. Fighting began on the 3rd of April, when a bold attempt was made to reach Versailles. Mont Valérien, however, stood in the way, its commander remaining faithful to the government of Versailles. The Communists had to retire, and after this repulse they acted simply on the defensive. But the defence was a stubborn one, and every inch was contested on the road to the north-western gates of Paris, on which the attack of the Versailles troops was apparently directed; while unceasing efforts were made to overcome the fire of the forts on the south-western side, so as to secure an entrance near the Point du Jour. All citizens capable of bearing arms were forced to join the national guard; the Archbishop of Paris and many other persons of

eminence were seized as hostages; public worship was forbidden in the churches; many arrests were made; railway companies and other public bodies were laid under heavy contributions; and finally, the folly and petty spite of the Communists were consummated in the destruction of the Vendôme Column, and the sacking of the private residence of M. Thiers. The feeling of Paris was not, however, so antagonistic to its new tyrants as might have been expected. Public order was fairly preserved, there was little or no plundering of private property, and the streets were remarkably safe. The cause of the Commune was also felt to be in a measure the cause of Paris; and the Parisians, indignant at being refused their municipal liberties, formed an accurate estimate of the hostility with which the reactionary deputies from the provinces regarded the metropolis. M. Thiers waited for seven weeks until MacMahon, to whom he had intrusted the supreme command, was quite satisfied that he might attack without much risk of failure. The Communists were slowly beaten back during this interval, and it was in vain that the military abilities of Bergeret, Cluseret, Dombrowski, Rossel, and Delescluze were tried in succession. Their troops sometimes fought badly, but generally with great ardour and reckless courage, although the struggle was almost a hopeless one. Towards the middle of May it was evident that the end was near. Fort Issy was evacuated on the 9th, and Fort Vanves was taken on the 18th. The whole of the western and south-western side of Paris was cruelly and persistently bombarded, and an amount of destruction was caused in Paris by French artillery vastly greater than that done by German cannon. At length, on Sunday the 21st of May, a portion of the Versailles troops found a point on the south-western front deserted, and entered the city without a struggle. Reinforcements were rapidly poured in, and before midnight the army of attack was encamped within the walls of Paris.

Then came a week of horrors. Early on Monday morning, the 22nd, the government troops poured through the Arc de Triomphe and along the quays to the Champs Elysees, and as the Communists now knew that the hour of inevitable defeat had come, those who were in the secret of their supreme designs hastened to carry into execution the project of involving Paris in their ruins. If Paris did not belong to them, they vowed that it should no longer exist. By midnight on Tuesday the palaces of the Council of State and of the Legion of Honour, on the south side; and the ministry of Finance, the Tuileries, and the Louvre, on the north side, besides numerous blocks of private houses, were in flames. The troops only arrived to find that the fire had done most of its work; and the exaggeration of alarm inspired the belief that, by some fiendish contrivance, the pumps used to extinguish the fire threw petroleum on the burning masses; while rumour asserted that, through that night, and in the subsequent days of conflagration, dreadful women stalked through the streets setting houses on fire with petroleum. Wednesday and Thursday were days of terrible fighting, with the city blazing on all sides. The Palais Royal and the Hôtel de Ville were fired on the former day, and the docks of Villette, the Lyrique and Porte St. Martin theatres, and the Palais de Justice on the latter; but the troops had come in time to save the palace of the Corps Législatif, the Luxembourg, and the Sainte Chapelle, while Notre Dame was saved by the courage of a few civilians. Meanwhile, every inch of the ground had been disputed, and the troops, who were very carefully and judiciously handled, proceeded slowly in order to turn the formidable barricades which presented themselves on every side. On Friday the communists were driven out of the Place de la Bastille, and the troops which had been advancing on the two sides of the river came to a point of junction. All resistance was at an end on the southern side; and on Saturday the troops carried the last great retreat of the Communists at the Buttes Chaumont on the north-east. The struggle continued, however, throughout the greater part of Sunday; for many of the insurgents, driven to bay, preferred to die with arms in their hands rather than surrender themselves to the vengeance of their conquerors. But the desperate men who headed the insurrection in its last week had not merely set Paris in flames; they had murdered in cold blood the Archbishop of Paris and others, whom they had reserved for execution under the name of hostages. Unfortunately, also, the conscience of the civilized world was no sooner shocked by the tale of the mad excesses of the Communists, than it was shocked equally by the tale of the cruel vengeance wreaked on them, by the wholesale and cowardly massacres perpetrated by the soldiers on Parisians who were as defenceless as sheep before the butcher.

Meanwhile, a definite treaty of peace had been signed at Frankfort and ratified, by which it was stipulated that the payment of the first half-milliard of the indemnity should be paid within thirty days after the occupation of Paris by the government troops, another milliard during 1871, a further half-milliard by May, 1872, and the remaining three milliards by May, 1874. The evacuation of the departments around Paris, and of the northern forts, was only to be made when the German government considered order sufficiently established in France, or when the third half-milliard should be paid. At the beginning of July the French government issued a new 5 per cent. loan with great success, and was enabled to pay up a milliard in September, in addition to the half-milliard paid in June, so that in September the northern forts and the departments near Paris were freed from the foreigner. Great difficulty, however, arose in the departments still occupied, where the humiliation and annoyance of the occupation were keenly felt; and in October a further convention was made, by which it was agreed that six more departments should be evacuated, and the total occupying force reduced to 50,000 men, on condition that the further half-milliard, instead of being paid by May, 1872, should, together with the interest on the unpaid portion of the indemnity, be paid by instalments beginning in January and ending in May. The evacuated provinces were also to be left unoccupied by French troops, as a security for the payment of the indemnity. (A milliard is a thousand million; a milliard francs is therefore worth £40,000,000.)

In June, 1872, another treaty was concluded with Germany for the immediate payment of £40,000,000, to be followed by the evacuation of six more of the occupied departments. In August a loan of £140,000,000 was covered many times over by subscriptions. The wonderful success of this loan enabled the government to make arrangements for still further hastening the period of the final evacuation of French territory by their German conquerors; and Verdun, the last stronghold held by them, was given up in September, 1873.

There can be no doubt that the very satisfactory result thus arrived at was due to a great extent to the wonderful ability shown by M. Thiers, and to the confidence with regard to France which he inspired throughout Europe. For more than two years after the close of the war he appeared indispensable as chief of the executive government. His great reputation, his parliamentary ability, and the invaluable services he had rendered to the country, seemed to place him beyond the reach of competition. In the autumn of 1872, however, M. Gambetta delivered at Grenoble a speech remarkable for its violent ultra-republican views; and from this time a reaction took place in the Assembly, and the republic, to which M. Thiers had given his complete adhesion, came to be regarded with extreme suspicion. Soon after the Assembly met in May, 1873, a motion adverse to the government was carried by a majority of fourteen. M. Thiers at once resigned, and the presidency was transferred to Marshal MacMahon. An attempt

was then made to re-establish a monarchy, and the Comte de Chambord would have been proclaimed king of France as Henry V., had he not at the last moment put forward some absurd pretensions as to his absolute rights, and refused to acknowledge the national tricolor. Failing the monarchy, the ministry then carried the appointment of MacMahon as president for a term of seven years. A considerable party in the Assembly were in favour of the definitive declaration of the republic, but in February, 1875, this was evaded by a resolution which declared Marshal MacMahon to be "president of the French republic," thus tacitly recognizing this form of government without expressly binding the Assembly to it. While the executive was thus vested in the president, legislative functions were declared to rest with an Assembly of two houses, a Chamber of Deputies and the Senate, elected as we have already described. The Assembly then voluntarily placed a limit on its own tenure of power by enacting that the new legislature should meet on the 7th March, 1876. The elections previous to that date resulted in the return of a large republican majority. The National Assembly, whose functions thereupon ceased, was elected at the disastrous commencement of 1871, and though guilty of many errors it will occupy no ignoble place in history. The policy of Marshal MacMahon proved very unpopular, and in deference to a general wish he resigned early in 1879, when M. Grévy was elected president, the change being unaccompanied by the least disturbance of any kind. Under the rule of the National Assembly a great war was brought to a close, the Commune was overthrown, and public order was steadily maintained.

Napoleon III. died, after a painful illness, at Chiselhurst, in January, 1873. His son joined the British headquarters in Zululand, with the view of gaining military *prestige*. Early in June, 1879, however, he was killed by a party of Zulus, and left his position by will as chief of the Bonapartist party to Prince Victor, son of Jerome.

The policy of France within recent years has been such as to disquiet peaceable neighbours and to isolate herself from the goodwill of Europe. Tunis was in 1881 invaded under pretence of punishing a robber tribe of Kroumirs who had molested the Algerian border. Both Italy and England were assured beforehand that this was the sole object of the military expedition. Once over the Tunisian border, however, all pretence of punishing Kroumirs was dropped; and General Bréart rapidly advanced upon the capital, occupied it, and forced upon the bey a French protectorate. So open and shameless a piece of deception brought but scant popularity to the Ferry ministry, which was soon afterwards defeated and succeeded by one with M. Gambetta at its head. In the following January, however, the latter was overthrown on his proposal to alter the mode of election to the French Chamber by a majority of 305 to 110, and M. de Freycinet was recalled to power. In the difficulties which arose in Egypt in 1882 France went hand in hand with England, though slowly and hesitatingly, down to the critical moment when it became necessary to support diplomacy by action. Then she drew back, and single-handed England had to undertake the task of putting down rebellion and restoring a settled and stable government to the country. The proceedings of England, however, were watched with the bitterest jealousy, and, as if to conciliate French pride for the loss of influence in Egypt, the government fostered the revival of a spirit of intervention abroad, and entered upon projects for asserting French influence with a high hand in Tonquin, Madagascar, and Equatorial Africa.

The career of the brilliant and patriotic Gambetta had come to a close on the last day of 1882, and his death was followed a few months later by that of the Comte de Chambord, France thus losing her most distinguished republican and her most likely king. With the passing away of the great figure of M. Gambetta something like a disruption of the republican party seemed imminent; but this was averted by the folly of Prince Napoleon (Jerome). His manifesto, treating the republic as moribund and demanding a *plébiscite*, closed up the republican ranks, and was made the excuse for some severe measures against the Orleans family, the several members of which were removed from their positions in the army. The controversy with Madagascar was then pushed to the extreme of demanding a cession of territory and a large indemnity. The port of Tamatave was bombarded and occupied, but the native Hovas retired into the interior, and avoided an engagement. The high-handed proceedings of the French admiral towards the Rev. Mr. Shaw, an English missionary, had to be atoned for by an apology and a pecuniary *solatium*.

In Tonquin, about the same time (in 1883), France entered upon a task of greater difficulty than that of Madagascar. Her colonial government of Cochin-China had grievances of long standing against the Annamese in regard to the obstacles to trade in the northern province of Tonquin, caused by the Black Flags, or semi-piratical bands. To suppress these Commander Riviere was despatched with a small force, which, however, was repulsed and its leader killed. The government thereupon resolved to prosecute the matter warmly, and a large force under Admiral Courbet advanced on Hué, the capital of Annam, where a treaty was exacted, the result of which would be to reduce Annam to a position of dependency, and to give France the mastery in Tonquin. Against these proceedings a grave protest was entered by China, whose government had from the outset asserted her suzerainty over the Annamese dominions and especially Tonquin. After prolonged negotiations a treaty of the nature of a compromise was signed in May, 1884, but the Chinese failed to carry out its provisions as understood by the French, a contest took place between French and Chinese troops, in which a number of lives were lost. France, of course, protested against this breach of faith, and demanded the payment of an indemnity; but the government at Pekin proved to be in no yielding mood. When diplomatic menaces failed, a French squadron attacked the forts near the entrance of the harbour of Foochow, and inflicted some damage on them as well as on the arsenal and some worthless Chinese vessels. Hostilities continued with small success on the part of the French until March, 1885. The French forces under General Négrier, had been forced to retreat. The news of this reverse produced great excitement at Paris, and led to the fall of the ministry of M. Ferry, but almost immediately afterwards news was received that a treaty of peace had been signed with China, the French abandoning their claims for an indemnity. The Brisson Ministry held office until after the French elections, which took place in October, 1885, but resigned on 31st December, and was succeeded by the ministry of M. de Freycinet, during whose term of office the protracted hostilities with Madagascar were brought to an end by a treaty signed in February, 1886, whereby a French protectorate over the island was established, with control of its foreign relations, some points on the coast remaining also in the hands of the French.

FRANCE, ISLE OF. See MAURITIUS.

FRANCHE COMTÉ was the later name of what was originally the county of Burgundy. The reader is referred to the article BURGUNDY for the many different states which at various times passed by that name. The county of Burgundy comprised the modern departments of the Haute Saône, Jura, Doubs, and their immediate surroundings, with Dôle for its capital. Besançon was also one of the chief towns. Franche Comté was annexed to the empire by the Emperor Barbarossa, and remained a German fief till its reconquest by Louis XIV. in 1668.

FRANCHISE, ELECTORAL. The franchise is the right or privilege of voting in the election of members

for representing counties or boroughs in the House of Commons.

Household suffrage was the old Saxon suffrage of this country, the immemorial Teutonic custom which our ancestors brought with them from the shores of Sleswick and the Elbe, and which William the Conqueror found so firmly rooted among his new people that he continued to use it as the basis of administration. See COUNTY COURT.

The *County Franchise* began when the lesser barons or freeholders were invited to send representatives to join the great barons in consulting on the welfare of the kingdom in the minority of Henry III. At the "father of Parliaments," De Montfort's Parliament of 1265, the two knights of the shire which he desired each county to send up to Parliament (to meet for the first time two burgesses from each borough), were elected in the county court by the freeholders assembled. But as a question was raised as to the power of householders also to vote at these elections, it was decreed in 1376 that *all* present at the meeting could vote. Eventually these representatives were found sometimes not sufficiently compliant to the royal will, and one of the charges against Richard II. justifying his deposition was that he had ordered the sheriffs to return two knights of the shire without holding an election. Even when this was remedied the sheriffs would "amend the return" by putting in another name for the one properly elected. Therefore in 1410 stringent regulations as to the purity of returns were made, enforced by heavy fines, and in 1413 the franchise was regulated by the limitation of residence. Again in 1432 it was provided that the land on which the claim was made must be within the county voted for. Still closer restrictions followed, and finally, from the seventh year of Henry VI. until the passing of the Reform Act in 1832, the right of voting was held by all persons having a freehold estate of the value of 40*s.* All copyhold tenures were excluded.

Borough Franchise.—The burgesses were nominated in the borough assembly under widely varying franchises. In some places, as York, &c., the county regulations prevailed. At London the lord mayor and aldermen, with a few assistants, elected till 1375; then for a century the common council; then, after 1485, the general body of the livery-companies. But usually throughout the country all householders (men paying *scot and lot*), all holders by burgage tenure, or members of corporations, and all freemen of any guild or of the borough voted. In 1413 residence was made compulsory, but this was found to be neglected in practice, and the provision was repealed in 1774. The Tudors, and also Charles II., created many boroughs with close corporations, to whom alone the right of voting was given, in order to secure votes in the Commons.

The franchise was greatly extended by the Act of 1832, which conferred the right to be registered as an elector in a city or borough upon every male person of full age, and not subject to any legal incapacity, who for twelve months previous to the last day of July had occupied any tenement at a rental of £10 per annum, for which he had been rated to all rates for the relief of the poor made during his occupation, and had paid all poors' rates payable in respect o the premises to the 5th January preceding. In counties, besides the 40*s.* freeholders above mentioned, £50 tenants at will were given the right of voting. By the Reform Acts of 1867 and 1868 the £10 rental limit in boroughs was removed, and in both England and Scotland the franchise was extended to every householder who complied with the provisions of the Acts with regard to residence and payment of rates, which were the same as in the Act of 1832. All lodgers, too, who had occupied apartments for at least a year, which, if unfurnished, would let for £10 per annum, received the right to vote. In Ireland the borough franchise included lodgers under the same conditions as in England and Scotland, but a rental of £4 was fixed for householders. By the same Acts the county franchise was reduced to a £12 rental in England (it had previously been lowered to that amount in Ireland) and to £14 rental in Scotland. In 1884 an Act was passed under which a uniform residential household and lodger franchise was established throughout the United Kingdom, on the basis of those already existing in the boroughs, as above described. It also created a new franchise, called "a service franchise," by which the right of voting was conferred on anyone who occupied a house—not as owner or tenant, but "by virtue of any office, service, or employment"—which was not also occupied by his employer. The property qualification in counties, under which all freeholders of the annual value of 40*s.* and upwards had been entitled to vote for centuries (whether resident in the county or not), was not interfered with. The Act was followed in 1885 by a sweeping measure of redistribution, which will be found described in the article on REFORM ACTS.

Many democratic governments have endeavoured to carry out the theory that all who have an interest in the welfare of the state through being born and living in it, have an inherent right to equality in voting influence in the affairs of that state, but all in practice have established an age limit.

FRAN'CIA, DR. JOSÉ GASPAR RODRIGUEZ, a Dictator of Paraguay, said to have been born near Asuncion, the capital of Paraguay, in 1757 or 1758. His father was a European, his mother a Creole.

Establishing himself in the town of Asuncion, Francia spent there some thirty years of his life as an advocate. He never, we are told, would defend an unjust cause, and was ever ready to take the part of the poor and weak.

The revolution which brought about the independence of the Spanish possessions in South America began in Buenos Ayres in 1810, when Francia was fifty-two or fifty-three years old. Paraguay did not join the other La Plata provinces, but after a time declared its independence, and set up a junta, with Don Fulgencio Yegros as president and Francia as secretary. Yegros and the others, however, could not get on with him—or he with them—and he soon resigned his post, retiring to a country house in the neighbourhood of Asuncion. Everything now went from bad to worse; until a new congress, which assembled in 1813, placed Francia and Yegros at the head of the republic under the name of joint consuls. From this moment the state of public affairs began to improve. The country was protected from foreign invasion by Francia's non-intercourse system. The peculiar character which had been impressed by the Jesuits upon society in that country probably contributed to the more strict enforcement of this extraordinary measure. Ingress and egress became nearly impossible for any purpose. Francia's joint consulship had been converted in 1814, by a third congress, into a dictatorship for three years, and then in 1817 into a dictatorship for life. Yegros, in 1819, involved himself in destruction by engaging in a conspiracy for the assassination of his former colleague, the detection and defeat of which consolidated and greatly strengthened Francia's power. This conspiracy led to the reign of terror, as it has been called, during which about forty persons were put to death.

The reign of terror (a term of gross exaggeration) once over, Paraguay was blockaded from within, as already mentioned. For twenty years did the remarkable isolation of Paraguay rigidly continue. The best description of this extraordinary man and his work is undoubtedly the picturesque essay of Carlyle in the *Edinburgh Review*, 1843 ("Miscellanies"); and the best authentic original authority is the little French book of Messrs. Rengger and Longchamp, two Swiss surgeons, who went on a natural-history expedition into Paraguay in 1819, were there as usual detained as foreigners, and (what was very unusual) were afterwards in 1825 let go by Dr. Francia. This

spotlessly pure divinity-doctor, this rigidly honest lawyer, rose to a degree of power excelling that of Cæsar or Napoleon for completeness and duration. In 1820 locusts destroyed the crops, for instance: Francia commanded the farmers to sow afresh, and was obeyed without a single delinquent. It resulted, as his studies had led him to believe, in Paraguay yielding two harvests in the year. Brigandage was, as might be imagined, rife: Francia entirely abolished it. Taxes were difficult to gather, and tax-gatherers inclined to peculation: the dictator shot one or two of the worst rascals and had no more trouble. The times were rough, and this ruthlessly just man alone was equal to them. For himself he was abstemious to austerity: three cigars a day, a cup of maté tea, a quarter of a pound of meat, and a slice of bread being his unvarying rations. He fancied a portrait of Napoleon of Rengger's, and asked to be allowed to buy it. Rengger gave it him. He sent it back. He did not allow himself to take presents. It is considered remarkable in Peter the Great to have built St. Petersburg; Francia did more. He found the capital, Asuncion, overrun with nuisances of all kinds through the luxuriant vegetation crowding the unpaved narrow streets. By his decree the inhabitants rectified the town themselves, those whose houses were inconveniently placed pulling them down and erecting them elsewhere, the dictator looking on with his all-directing theodolite. In the great square a gibbet permanently stood, a workman's gibbet; and if Francia heard of a workman making bad work, and found the accusation to be true, he caused him to be walked to and fro under this gibbet six times, as a caution, giving him the assurance that further bad work would lead to swinging and not walking under the gallows. Yet so much did the people feel that this severity was but the chastisement of a stern father doing what he considered his duty, that when, after ruling them for twenty-six years, the dictator died, they crowded round the government house with bitter weeping.

Francia died on the 20th of September, 1840, and the dictatorship was succeeded by a directory of three persons. Paraguay still continues a republic, electing its president in a more regular manner, and maintaining largely the spirit of isolation inculcated by Francia.

FRANCIS I., OF FRANCE, was the son of the Count of Angoulême, grandson of that Louis I., duke of Orleans, who was assassinated by John, duke of Burgundy; and through Louis of Orleans was a descendant from King Charles the Wise. His mother was Louisa of Savoy, headstrong and unprincipled. On the death of the Count of Angoulême, Francis was taken into the charge of King Louis XII., who afterwards gave him his daughter Claude in marriage. Francis succeeded to the throne of his father-in-law at the age of twenty-one, in January, 1515. Before that year ended he had won a great battle over the Swiss at Marignano, and taken possession of Milan as his duchy, on a right derived from his grandfather Valentine. The following year was chiefly spent in allying himself with his former enemies, the Swiss, and with the Venetians and the pope, the better to be prepared against the formidable opponent who at the same time appeared in the political horizon—Prince Charles of Austria, afterwards the Emperor Charles V. Both became candidates for the imperial crown on the death of Maximilian in 1519, and Francis was defeated. It was at this period the meeting of the Field of the Cloth of Gold took place between our Henry VIII. and Francis, between Guisnes and Ardres, to cement an alliance proposed between the young kings against Charles. War broke out in 1521 between Charles and Francis, by the latter attempting to recover Navarre for the family of Jeanne d'Albret, and to support the Lord of Bouillon against the emperor; and this ended in a combination against him of the emperor, the King of England, and the pope, in 1521. To make matters worse, the Constable de Bourbon, driven into hostility by the persecution of the queen-mother [see the article BOURBON, THE CONSTABLE DE], abandoned France and took service under Charles. Milan and Genoa were lost, but in other parts the French arms steadily maintained themselves. In 1524 the French were defeated on the Sesia, when Bayard fell—"the knight without fear and without reproach." Milan was taken by Francis in the same year; but while he was delayed before Pavia, which was most gallantly defended by Antonio de Leyva, the imperial generals acted with such vigour and skill in reorganizing their forces that they attacked him on the 24th of February, 1525, utterly defeated him, and took him prisoner. "All is lost but honour," wrote Francis to his mother. The heroic lady assumed the reins of government and saved the kingdom. Francis remained a captive at Madrid until the following year, when, by the treaty of Madrid, he recovered his liberty, on engaging by his oath and honour to cede Burgundy, renounce his claims on Italy, Flanders, and Artois, marry Eleanor, queen-dowager of Portugal, give as hostages two sons, &c.; all which engagements he determined to break at the very time he made them. As soon as he entered France he galloped off, exclaiming, "I am yet a king."

War broke out with renewed intensity, and now England and the pope were on Francis' side. Charles accused Francis of perjury, but the pope absolved him, and Francis vainly, in his chivalrous way, challenged Charles to single combat. Milan and Rome were taken by the imperialists; Genoa broke from the French alliance, and before Naples and in the Milanese territory the French were destroyed by disease. Another treaty followed in 1529, the sons were ransomed, and there was a brief pause. Francis soon recommenced hostilities by seizing Savoy in 1535, while Charles was in Africa; but on the return of the latter the French troops were driven out, and after struggles of varying fortune, a cessation of arms was agreed to at Nice in 1536. It was in this campaign that Francis allied himself with the Grand Turk for the first time. An interview took place between Francis and Charles. The French king went on board the emperor's galley, and the latter returned the visit at Aignes-Mortes. A better understanding followed, and it was not until 1542, when the French ambassador was murdered at Milan, that hostilities were renewed. In the battle of Cerisoles, 11th April, 1544, the French conquered; but a new Turkish alliance revolted Christendom, and several kings uniting against Francis in September following a peace was concluded at Crespi. In 1547, on the last day of March, Francis died.

The great fact of Francis' reign is his successful opposition to the universal monarchy aimed at by the house of Austria in the person of the Emperor Charles; and the support he, a Catholic and a bigot at home, gave to Protestantism in Germany in order to weaken his rival. By Claude, his first wife, Francis had three sons and four daughters; the eldest son was supposed to have been poisoned by a partisan of the emperor, the next son succeeded as Henry II. His second wife, Eleanor of Portugal, bore him no children. He is said to have owed his death to the vengeance of the husband of one of his numerous mistresses. He encouraged those profligate manners at court which were so fully developed in succeeding reigns. As a patron of art and literature, Francis I. ranks deservedly high. He favoured Erasmus, patronized Cellini, and received the last dying breath of Leonardo da Vinci.

FRANCIS II. OF FRANCE, born in 1543, was the eldest son of Henry II. and of Cathérine de Médicis. He married in 1558 Mary Stuart, only daughter of James V. of Scotland. On the death of his father, 10th July, 1559, Francis became king, being then sixteen years of age. He intrusted the government to Francis, duke of Guise, and his brother, the Cardinal of Lorraine, uncles of Mary Stuart, both bigoted Roman Catholics. This was the cause of the

civil and religious wars which desolated France for half a century. The King of Navarre, and Louis his brother, prince of Condé, conspired against these ministers, and joined the Protestants. In March, 1560, the Guises removed the king and court to the castle of Amboise; the king named the Duke of Guise lieutenant-general of the kingdom, and a number of persons were by him arrested and executed. Soon afterwards the edict of Romorantin was issued, which constituted the bishops judges of heresy, and took the cognizance of this offence from the Parliaments. The Huguenots (Protestants) felt the net being drawn slowly round them.

By an edict of 1559 Lutheranism had been declared punishable by death. Extreme measures, however, were delayed until the king assembled the states-general at Orleans, when the Prince of Condé, on his arrival, was arrested on the charge of a conspiracy, and condemned to lose his head; but he was saved by the death of the king himself, 5th December, 1560. He had reigned only seventeen months. He was succeeded by his brother Charles IX., then a minor. Mary, his widow, afterwards became by inheritance Queen of Scotland, and returned to her country, there to cause bitter woe, and to spend most of her remaining life in an English prison.

FRANCIS I., EMPEROR OF GERMANY, born in 1708, was the son of Leopold, duke of Lorraine, who was the son of Charles V. of Lorraine, and of Eleonora Maria, daughter of the Emperor Ferdinand III. Francis' mother was the Princess of Orleans, niece of Louis XIV. On the death of his father in 1729, Francis succeeded him as Duke of Lorraine and Bar. In consequence of the war of the Polish succession, Lorraine was ceded to Stanislaus Leczinski, father-in-law of Louis XV., to revert after his death to the crown of France; and Francis received in exchange Tuscany, which duchy became vacant by the extinction of the house of Medici. Francis married in 1736 Maria Theresa of Austria, the only daughter and heiress of the Emperor Charles VI. In 1740 Charles VI. died, and Maria Theresa succeeded him in the hereditary dominions of the house of Austria; she made her husband co-regent with herself, but gave him little share in the administration. He, however, commanded her armies in the war which she had to sustain in order to secure her inheritance. [See MARIA THERESA.] After the death of the Emperor Charles VII. in 1745, Francis was elected his successor on the imperial throne. In 1748 the peace of Aix-la-Chapelle restored peace to Germany and to Europe; but in 1756 a new war broke out between Prussia and Austria, known by the name of the Seven Years' War, which was terminated by the peace of Hubertsburg, in February, 1763. The following year Joseph, the eldest son of Francis, was elected King of the Romans, and in 1765 Francis died at Innsbruck, and Joseph succeeded him as Emperor of Germany (Joseph II.), his mother retaining in her hands the sovereignty of the Austrian dominions till her death. One of the daughters of Francis was the unhappy Marie Antoinette, queen of France.

FRANCIS II., EMPEROR OF GERMANY (Francis I. of Austria), the eldest son of the Archduke Leopold, who afterwards became emperor as Leopold II., and of Maria Louisa of Spain, was born at Florence in February, 1768. He was most carefully educated at Vienna by his uncle, Joseph II., at whose death he directed the government until his father arrived from Florence. Leopold died in 1792, and Francis succeeded to his vast dominions, and was also elected emperor. It was a critical time. Joseph's reforms had excited great discontent, the Belgians were in revolt, and the French Revolution drove France to declare war against Austria. This first war with France afforded the opportunity for the military genius of Napoleon to disclose itself. Austria was completely beaten, and the war ended in the exchange of Belgium and the duchy of Milan for Venice and Dalmatia, by the treaty of Campo-Formio. The second war, in coalition with Russia and England, was marked by the loss of Lombardy and the battles of Marengo and Hohenlinden in 1800, followed by the treaty of Luneville in 1801, when the emperor's brother gave up Tuscany and his uncle Modena. In 1804, when Napoleon declared himself Emperor of the French, Francis, foreseeing the dissolution of the German empire, declared himself hereditary Emperor (instead of king) of Austria. Entering into a new coalition with Russia and England, a third war began, which was marked by the French entering into Vienna, the capitulation of Ulm, the battle of Austerlitz, and the peace of Presburg in 1805, when Austria gave up the Venetian states and Tyrol. The German Empire, 1000 years old, was dissolved, and Francis' title henceforward was Emperor of Austria, King of Bohemia and Hungary. In 1809, alarmed at Napoleon's encroachments, and taking advantage of his embarrassment in Spain, Francis commenced his fourth war with France, and was supported to a great extent by the people of Germany. His general, the Archduke Charles, had to abandon Vienna, the indecisive battle of Aspern was fought, with great loss on both sides, that of Wagram followed, and at last an armistice was concluded in 1809, by which Austria gave up Trieste, Fiume, and Croatia, Salzburg, and part of Galicia. In 1810 Napoleon married Maria Louisa, the daughter of Francis; and during the Russian campaign in 1812 the Austrians rendered the French some slight aid. In 1813 Austria resumed its neutrality, and proposed to mediate between France and Russia. Napoleon refused; Francis joined the allies, helped to win the battle of Leipzig, and followed the Russians and Prussians to Paris in 1814. He then returned to Vienna, where the memorable congress began its sittings and redrew the map of Europe. The escape of Napoleon from Elba brought Austria forth for the sixth time in war with France, when one Austrian army advanced to Lyons, while another drove Murat from Naples and re-established King Ferdinand. Francis rendered this king some further aid in 1821 against his own subjects. He refused to interfere when the French Revolution of 1830 broke out, and thus helped to save Europe from another general war. He died on the 2nd of March, 1835, and was succeeded by his eldest son, Ferdinand. One important feature of Francis' domestic administration was the establishment of elementary schools throughout his dominions. His nature was warped by his dread of revolution. The judicial murder of his aunt, the hapless Marie Antoinette, was ever in his mind, and he was a slave to reactionary ideas, from which Austria suffered much both at his hands and since.

FRANCIS, ST., the founder of the order of mendicant friars called after his name Franciscans, was born at Assisi in Umbria in 1182. His father, one of the Bernardini family, was a merchant, thriving and keen for gain. In his early life Francis, associated with his father in business, was distinguished by his gaiety and love of amusement, but in consequence of serious meditation, induced by a fit of sickness, he determined to devote himself to religion, to almsgiving, and to all kinds of works of charity and self-denial. He encountered at the outset the strong opposition of his father, and when the young man, sent with some of his father's goods to sell, took the money for which he sold them to the priest of St. Damian's in order to help him to rebuild the ruined church, matters came to an open rupture. Francis fled and hid for weeks in a cave. Brought before the bishop, after much domestic persecution, amounting almost to torture, his vocation for the religious life was discovered, and he not only restored the money he had taken but cheerfully abandoned all claim upon his inheritance, and renounced all dependence upon his father. Stripping himself naked he cried, "I give up all, even the clothes I wear. Peter Bernardini was my father; I have now but

one Father, he who is in heaven." The bishop embraced him and clothed him with his own cloak, and he desired to take the enthusiast into his service. Francis preferred a life of religious mendicancy. In the fulfilment of his vow he hesitated at nothing, discharging the most menial offices without a murmur, tended the poor and the sick, and waited upon and kissed even the lepers in the hospital. Poverty he termed his bride; and he gave up the wallet, staff, and shoes, which formed his modest outfit, retaining only one coarse woollen robe, girt about with a rope, to bring his possessions to the lowest limit. This was in 1208. Two years afterwards he was joined by two associates at a lonely spot in the bend of the river called Rivo Porto, and in 1210 the number of his followers reached eleven. Very soon after this, however, the spirit of self-abasement displayed by the brotherhood attracted a large number of disciples, and the rule of the brotherhood, as drawn up by the future saint, was approved by Pope Innocent III. The three monastic vows of poverty, chastity, and obedience were rigidly enjoined; that of poverty was enforced with peculiar rigour, and the members were employed in preaching, in works of charity, and in missionary labours among Mohammedans and heathen. The order received the solemn approval of the pope in 1216, and when the first general assembly was held in 1219, 5000 friars belonging to it were present, and there were 500 candidates waiting for admission. Francis had long hesitated between the self-regarding solitude of the hermit and the active life of a missionary. His choice once made he plunged into it in his usual ecstatic way, set off for the East, and penetrated to the presence of the sultan, to whom he preached long and often. "Let your priests go with me into a fierce fire," said he, "and let it depend upon my safety in the fire whether you are converted." Upon the refusal of the Mohammedans, Francis offered to undergo the trial alone if the conversion of the sultan were his guerdon; but the sultan remained firm to Islam, though he loaded the saint with gifts. Francis flung the gifts away and sorrowfully returned. Francis died on the 4th of October, 1226, being laid at his own request upon the bare ground in his church, that he might fulfil his vow to the last. He was canonized by Pope Gregory IX., and the 4th of October, the day of his death, was appointed as his festival. Many miraculous incidents are recorded by Roman Catholic biographers in connection with his life, the most celebrated being that of the stigmata or wounds of the Lord. It is said that while praying on Monte Alverno he saw in a vision a seraphic figure extended upon a cross, and received at the same time the marks of the wounds of our Lord upon his body. Two black excrescences like the heads of nails grew from the backs of his hands and feet, while from the palms and soles it seemed as if points protruded, bent back and clenched: a wound on his side, which appeared at the same time, bled now and again so profusely as to soak his garments and defy his earnest humble attempts to conceal the glory which had come upon him. It is difficult to realize that this was not a matter of legend, but was believed as an actual occurrence by the whole of Christendom, save a few envious Dominicans, upon the death of Francis; when, since the saint had commanded that in the words of Scripture he should pass naked from the world, numbers of his disciples were able ocularly to convince themselves of the truth of the case. Pope Alexander IV. publicly declared he saw the marks with his own eyes. When, however, all allowance has been made for the fervour and imagination of his biographers, there remains sufficient in his life to show that he was a man of eminent piety, and one possessed of a pure, gentle, and loving spirit. His writings, consisting chiefly of letters, sermons, and hymns, were published in 1739.

Perhaps of all men who ever lived on the earth, save one, Francis of Assisi was the most beloved; nay, we may even say, the most adored; for his followers loudly claimed for him that he was as it were a second Redeemer. The fervour of the mystic devotion which he excited is at this distance of time almost incredible; and if we are compelled to call it a superstition, it was a superstition which had such an earnestness, warmth, and tenderness as to raise the religious feelings to an intense but gentle passion. In rude strains of metre, almost the oldest rhymes in the vernacular which Italy possesses, this pure soul sought to express its ineffable thoughts and enable poor folk who knew no Latin to share them. It has been mentioned above how he longed to fold all men in his close brotherly embrace; but his ardent mysticism drove him yet further. He claimed all creation as akin to him. He addressed the flocks of birds which gathered round the gentle friend whose love they were swift to perceive as "my brothers;" lambs and larks, he said, were images of cherubim and seraphim. He once reproved (some say, cursed) a created being: it was a hog who had killed and mangled a lamb. The anecdotes of his passionate love for all created things, and the care for dumb creatures which he was the first to inaugurate, with the pathetic recognition those mute "brothers" of his showed in every possible way, are among the most charming religious tales of the world. Francis did not stop at the brute creation. He calls on his sister the moon and his brother the sun. The wind is to him a brother also, and the water a sister; and when the surgeon's iron drew near him on the occasion of an operation performed upon him, he cried out, "Fire, O my brother, be thou discreet and gentle to me." His last word on earth was a smiling "Welcome, sister death." In him all men of whatever creed are irresistibly drawn to recognize the true saint.

FRANCIS, SIR PHILIP, the son of the Rev. Dr. Philip Francis (a well-known translator of Horace, whose translation until recently was almost universally used, and indeed, in a plain way, was a meritorious work), was born in Dublin, 22nd October, 1740. In 1750 he was placed at St. Paul's School, London. In 1756 he was appointed to a place in the office of his father's patron, Mr. Fox, then secretary of state. He afterwards held various other offices. In June, 1773, he was appointed one of the civil members in council for the government of Bengal, with a salary of £10,000, which he resigned in 1780, after a quarrel and duel with the governor-general, Warren Hastings, in which Francis was wounded. In 1784 he was elected member of Parliament for Yarmouth in the Isle of Wight. He supported the Whig opposition. Though the House refused to allow him to form one of the managers of the impeachment against Warren Hastings, his personal enemy, his co-operation was invited by the managers, and he took an active share in the business. When the war with France broke out Mr. Francis adhered to the party of Fox and Grey, and was one of the first and most active members of the famous association of the Friends of the People. At the election in 1796 he was rejected. In 1802, however, he was returned for Appleby. He now distinguished himself in opposition to the slave-trade, and, we may add, in opposition to his own private interest. On the formation of the Grenville administration Francis was made a Knight of the Bath, 29th October, 1806. He retired from Parliament in 1807, and afterwards occupied himself with occasional political pamphlets and contributions to the newspapers. In 1816 appeared Mr. John Taylor's publication entitled "Junius identified with a distinguished Living Character"—Sir Philip Francis. It may be affirmed that no case half so strong has yet been made out in favour of any of the other persons to whom the "Letters of Junius" have been ascribed. He died in London on the 22nd of December, 1818. The latest work on Sir Philip Francis is his Memoir, by Herman Merivale (London, 1868).

FRANCIS'CANS, or **GRAY FRIARS,** an order of mendicant preachers, or such as were intended to be so, founded by St. Francis of Assisi, and whose beginnings are briefly sketched in the article on that saint. The order founded by St. Francis spread with great rapidity after his death, and in less than half a century it reached nearly 200,000 adherents. The members consisted of friars, of nuns known as Poor Claras, from the nun Clara who had been converted by Francis, and who received the rule of the order from his hands, and Tertiaries, or brethern of penitence, consisting of persons who retained their customary avocations and relationships, but who abstained from fine clothing, worldly dissipation, &c., and practised works of special devotion and mercy. With increasing numbers, however, the difficulty of keeping the rule as to absolute poverty commanded by the founder led to considerable controversy. St. Francis had insisted that no one but those absolutely destitute should be received into the order. If a friar found money he was to trample it under foot; on no account was a friar to receive the accursed coin. If he was labouring for his support he was to be paid in food or clothing. Further, only one mass, and that without any pomp of ritual, was to be celebrated each day. Pride of learning was forbidden. Yet though Elias, the first general of the order, appointed while St. Francis yet lived, resigned his office when his infirmities compelled him to ride on horseback and so break the vow of destitution, a very few years saw the magnificent triple church of Assisi begin to rise, its walls destined to glow with Giotto's frescoes, its ritual to abandon all the severity the holy ascetic had commanded. Further, the great spread of the order, the crowd of Tertiaries or lay adherents, the consequent power thrust upon the friars, to whom all this multitude looked for guidance, led naturally, as one sorrowfully admits, to the lust of power. The Franciscans at first emulated the Dominicans, then each grew jealous and envious of the other, and finally, a bitter hatred raged for centuries between these two powerful bodies. (The struggle has now passed away from the Franciscans to the Jesuits, the Dominicans still continuing their race for supremacy in the councils of the church with their newer rivals.) But to cope with the Dominicans learning was necessary, and the rule had to give way. Alexander Hales, St. Bonaventura, Duns Scotus, William of Ockham (Ockham in Surrey), and Roger Bacon were the foremost men of learning of their time, so far had the order gone from its first principles. The friars (the Dominicans as well as the Franciscans) were also the most generous patrons of art for the decoration of their churches and monasteries. The people showered riches upon them in such profusion that the clergy and the older orders (Augustinians, Benedictines, &c.) complained that the country was impoverished by it. (See the Chronicle of Matthew of Paris on this head.)

As also from time to time reforming enthusiasts arose among the friars themselves, ultimately serious internal divisions broke out. From these controversies arose the bodies known as Observants, Cæsarins, Celestines, Soccolantes, Cuperolani, Conventuals, Capuchins, and many others. Some of these separate orders wandered away from the communion of the church altogether, and others were finally merged into the general body. The principal divisions now are the Observants, Conventuals, and Capuchins, the Franciscan nuns, and the Tertiaries. At the beginning of the eighteenth century the Franciscan order numbered nearly 120,000 friars and nearly 30,000 nuns, and though since the French Revolution the number has been greatly reduced, the order is still one of the largest in the Roman Catholic Church. It numbers among its members a long array of ecclesiastical scholars and eminent churchmen. St. Bonaventura, Alexander Hales, Duns Scotus, William of Ockham, and Roger Bacon have been mentioned. The celebrated Cardinal Ximenes, and the popes Nicholas IV., Alexander V., Sixtus IV., Sixtus V., and Clement XIV., also belonged to this order.

FRANCKE, a celebrated German philanthropist, was born in 1663. In 1691 he became professor at the University of Halle, and soon afterwards pastor of the parish of Glaucha, a suburb of Halle. The wretched state of his parishioners, who were sunk in the most abject ignorance and poverty, gave the first impulse to his philanthropic exertions. He began by teaching the children, whom he supported at the same time by small donations. He was assisted by the contributions of many charitable persons, and gradually extended the sphere of his beneficial activity. In 1698 he laid the foundation of the Orphan Asylum at Halle, though he had scarcely any means of completing the edifice. It frequently happened that at the most critical moments he received by post large sums from known or unknown benefactors. Francke died in 1727. Several important educational establishments at Halle, comprising education for all classes, owe to him their foundation and bear his name. One of these, the Cansteinian Biblical Institution, founded by Baron Canstein, was the forerunner of Bible Societies.

FRANCO OF COLOGNE was the monkish inventor of time-signs for music. Up till our own day this invaluable discovery was attributed to John de Muris (circ. 1330); but the labours of Fétis, Kiesewetter, and above all of Coussemaker, successively showed that De Muris was the pupil of De Handlo, and then that this De Handlo relied upon a treatise of a monk named Franco. Here authorities even yet differ, for there were two Francos renowned as musical theorists in the dark ages, one at Cologne in the middle of the eleventh century, and one at Paris rather more than a century later. The famous treatise, so far as we know it, gives no certain indication of its origin, being of course in the barbarous Latin of the time. The balance of opinion seems to be that Franco of Cologne was the inventor of notes, and that his namesake of Paris was one of the improvers of this luminous idea. It was not till the time of the latter (about 1170) that musical time-signs began to be generally used. These were at first the *long* and the *short* only, and early in the thirteenth century (about 1215) we find the *tiny* (minim) added to them. The long lasted as long as two shorts, the short two minims in imperfect time; the long was worth three shorts, the short three minims in perfect time. This triple division still remains, expressed among ourselves by the addition of a dot to the note to be divided. It is worthy of notice that the *short* note (brevis) of Franco is the longest note now in use, the breve.

FRAN'COLIN (Francolinus) is a genus of wading birds belonging to the family Tetraonidæ or Grouse, subfamily Perdicinæ or Partridges. The francolins are met with in Europe, Asia, and Africa. They have a strong family likeness to the partridges, but differ in their marking, by their stouter bill, and by one or two spurs on the leg. They love damp places in which the vegetation is rank, and frequent thick forests, perching at night in the branches. The Common Francolin (*Francolinus vulgaris*) is widely distributed over the south of Europe, Asia, and the north of Africa. It is about 12 inches in length, and is of a yellowish-brown colour above, marked and barred with black, and deep black beneath, with numerous oval white spots. Round the lower part of the neck there is a broad collar of chestnut red. This bird lives in numerous companies in the low and marshy districts of the forests, and perches freely upon the branches of trees. Its food consists of seeds and the bulbous roots of plants, which it is able to dig out of the soil. Its flesh, like that of the other francolins, of which there are many species, is very good. The Pondicherry Francolin (*Francolinus pondicerianus*) abounds in the Deccan, and is named by Indian sportsmen the Deccan partridge.

FRANCO'NIA (*Franken* or *Frankenland*) is a name that has at various times been very differently applied. It properly means the same as France, "the land of the Franks," and at an early time was applied to the territory embraced between the Loire and the basin of the Rhine and the Main. After a time the name became limited to that portion which was east of Lorraine. Previous to 1512 the territory was further split up into numerous divisions, but at this time the name was revived and formed a circle of the German Empire. It was bordered S. by Swabia and Bavaria, E. by Bohemia and the Upper Palatinate, N. by Hesse and Thuringia, and W. by the Lower Palatinate and the circle of the Upper Rhine. Its area was about 10,290 square miles. Its circle ceased to exist in 1806. The greater part of it is now included in the kingdom of Bavaria, of which it forms the three circles of Upper Franconia, Middle Franconia, and Lower Franconia, the united area of which is rather more than 9000 square miles.

FRANCO'NIAN EMPERORS is the title given to a very noble series of emperors of the Holy Roman Empire, or Western Empire, beginning with Conrad in 1027. They received this title on account of Conrad being a prince of Franconia, the Eastern or Teutonic *Francia*, so called to distinguish it from the Western or Latin *Francia* (France). Conrad was succeeded in the empire by his son Henry III. (1039), who was one of the greatest of the mediæval emperors, and a stern religious reformer; he was also a great friend of Edward the Confessor of England. His son Henry IV. succeeded in 1056, and waged that long and terrible strife with the popes, notably with the famous Hildebrand (Gregory VII.), which ended in his complete defeat and submission to penance in the snow at Canossa in 1077. Henry V. was the son of Henry IV., and succeeded in 1111. It was he who married Matilda the daughter of our English Henry I., whence that princess was known as the "Empress Maud." Her son (our Henry II.) was not by the emperor, but by her second husband Geoffrey, count of Anjou. With the Emperor Henry V., who had no son, the Franconian dynasty came to an end in 1125, and was succeeded by the Swabian line, springing from a daughter of Henry IV.

FRANGIPA'NI, one of the great mediæval Roman families; on several occasions, indeed, the complete masters of the eternal city. The name, it is said (breakers of bread), was a sobriquet of honour given in gratitude for lavish distributions of bread during a famine in the seventh century. The family rose to greatness at the close of the tenth century (987), withstanding the encroachments of Pope John XV. in a noble and popular way. The favourite attitude of the Frangipani was what was in later times called Ghibelline or anti-papal. Thus they were ever ready to support the western emperors and to aid the people against papal tyranny. It was a Frangipani who seized Gelasius II. and kept him prisoner when the cardinals elected him secretly in 1118 as a defiance to the Emperor Henry V., the more fortunate inheritor of his father's life-long struggle with the papacy. Cencius Frangipani had to yield up his prisoner in a few days to superior force; but the power at this time of these great nobles is shown in their daring to proclaim a pope in 1124 on their own authority, and this against the election of the church, which was then enthroning the chosen cardinal in San Pancrazio. To avoid a schism the latter gave way, and the legate Lambert of Ostia was borne to his throne by the Frangipani in full triumph as Honorius II. He prudently, however, sought a fresh election at the hands of the cardinals with all the due ceremonial. A rival house, that of Pietro Leoni, now rose to contest the supremacy with the Frangipani—the ancient monuments of Rome became battlemented fortresses, and war upon war was waged in a petty scale. The noble Arch of Titus, near the Forum, was one of the fortresses of the Frangipani. In fact, their fortress buildings were not pulled down and the arch cleared and restored until the days of Pius VII. (1822). They held the Colosseum for a long time as a fortress also, but when their fortunes declined they were driven from this stronghold by the Annibaldi. (Yet its desecration by the men-at-arms is not more painful than its plunder for building stones by the popes, or its conversion into cloth-mills by Sixtus V., or into salt-works by Clement XI.) The similar fortifications of the Colonna family at the Porta Maggiore are preserved to this day. If, however, a foreign enemy drew near the nobles would unite to withstand him, resuming their own quarrels on his departure. An example of this remarkable state of things is found in the united resistance of the two great houses to the Emperor Barbarossa (Frederick I.) in 1167, during and after his conquest of Rome. The Frangipani went so far as to seek foreign alliances against the great Swabian emperor by the marriage of their chief with a daughter of the Greek Emperor Manuel, and the grateful Pope Alexander III. blessed the nuptials (1172). This temporary alliance with the popes did not, however, last long, and a half century later we find the Frangipani more imperial than ever. The second Frederick won them over to be his liegemen, and thought no treasure too great to be lavished upon them. He even bought their lands, paying heavily for them, and then granted them back without fine as an imperial fief, thus converting them from independent nobles into barons of the empire. The result was seen in the pope (Gregory IX.) when daring to excommunicate the emperor, being at once driven out by the people, and having to take refuge in Perugia. He was not permitted to return till a severe flood about a year later frightened the superstitious people, who saw in it a punishment for their exile of the pope. Later popes used golden arguments to secure the Frangipani, even raised them to the principality of Tarentum. The family, however, was already paling before the great houses of Orsini and Colonna. A Spanish raid upon their lordship of Astura near Rome cost them both lives and property, and of the chief branch only one remained, John Frangipani. He finished the history of his once famous race by selling the last scion of the Swabian house of Germany, the youthful Conradin, who fell into his hands after his defeat at Tagliacozzo, to his remorseless rival Charles of Anjou (1268). That royal brother of St. Louis of France had the equally royal Conradin slain as a common criminal, and paid John Frangipani with large estates in the princedom of Benevento. The fierce race must have sadly fallen before it could accept the part of the paid assassin.

FRANK'ALMOIGNE. This tenure is thus described by Littleton (sec. 133):—"Tenant in Frankalmoigne is when an abbot or prior, or other man of religion, or of holy church, holdeth of his lord in frankalmoigne; that is to say, in Latine, *in liberam eleemosinam*, that is, in free almes. And such tenure beganne first in old time. When a man in old time was seised of certain lands or tenements in his demesne as of fee, and of the same land infeoffed, an abbot and his covent, or prior and his covent, to have and to hold to them and their successors in pure and perpetual almes, or in frankalmoigne; or by such words, to hold of the grantor, or of the lessor and his heires, in free almes: in such case the tenements were holden in frankalmoigne." From this it appears that lands which are so held by religious bodies are held by tenure; but neither fealty nor any other temporal service is due. The spiritual services which were due before the Reformation are described by Littleton in s. 135.

On this section (s. 135) Coke remarks:—"Since Littleton wrote, the liturgie or book of Common Praier of celebrating divine service is altered. This alteration notwithstanding,

yet the tenure in frankalmoigne remaineth; and such prayers and divine service shall be said and celebrated as now is authorized." The statute of 12 Charles II., which abolishes military tenures, expressly excepts tenure in frankalmoigne.

FRANKE'NIA, a genus of plants which are separated as a distinct order, FRANKENIACEÆ.

Frankenia pulverulenta (or the powdery sea-heath) grows in the sand by the sea-shore in many parts of Europe and Asia; it is occasionally found on the coast of Sussex in England, but is very rare.

Frankenia lævis is a native of the muddy salt-marshes by the sea-coast in many parts of Europe and the Canary Isles. In England it is found principally on the eastern coast, and flowers in the months of July and August. The flowers are generally flesh-coloured, but sometimes white, with yellow claws.

FRANKENIA'CEÆ, a small order of Dicotyledons allied to CARYOPHYLLEÆ. There are twelve species, chiefly found in the south of Europe and north of Africa; they, however, occur on the sea-coast in various other parts of the world; one species from Australia, *Frankenia pauciflora*, remarkable for the size of its flowers, is a very pretty greenhouse shrub. The only genus is FRANKENIA, of which there are twelve species. The characteristics which mark them off from the Caryophylleæ are the parietal placentas and the straight embryos.

FRANK'ENSTEIN is a town in the Prussian government of Breslau, situated on the Pausebach, 37 miles S.S.E. of Breslau. It is a well-built town, surrounded by walls, and has four suburbs, an old ruined castle, a spacious market-place, several churches, an hospital, barracks, a picture gallery, and a botanical garden. The population is about 7500. The manufactures consist of woollen stuffs, linens, leather, stockings, tobacco, liqueurs, &c. About 7 miles to the south-west is the mountain fortress of Silberberg, constructed by Frederick the Great to command the road from Bohemia.

FRANK'FURT, COUNCIL OF. This important and curious early council of the Roman Church met in 794 at Frankfurt-on-the-Main, summoned by the Emperor Charles the Great (Charlemagne). One of its chief objects was the suppression of a variety of the Nestorian heresy which under the name of Adoptians had sprung up in Spain. Elipand, archbishop of Toledo, and Felix, bishop of Urgel, perhaps with a hope of easing the path towards conversion for the Moors, had some time before this imagined that though the Son was coequal with the Father as to his divine nature, he was but an *adopted* Son as to his human nature. The heresy was widely welcomed. The council condemned the heresy (for which the bishops had themselves done penance forty years previously), and Charles himself drew up and pronounced the sentence. Still more important was its reversal of the permission of the worship of images granted by the second council of Nicæa. This too, the good emperor enlarged upon in the treatises known as the "Carolinian Books." He there rejects the kneeling to images, burning lights or offering incense before them, or kissing them, or in any way reverencing or adoring them; he admits images into the church as ornaments only. The council lays down firmly, too, that there is no special sacred language, but that prayer may be offered up in any tongue, a remarkable piece of liberality for the times. After this the council went on to fix the price of corn, to regulate the coinage, to issue decrees as to feudal matters, &c. In short this curious council and diet in one is an excellent example of the early mediæval view of the clergy as feudal beneficiaries, who like other feudal estates from time to time assembled round their liege lord. The decisions of Frankfurt were quietly passed by in later times.

FRANK'FURT-ON-THE-MAIN is on the right bank of the Main, across which there are four stone bridges and an iron suspension bridge, which unite it with the suburb of Sachsenhausen. The old walls and ramparts with their stagnant ditches were razed between the years 1806 and 1812, and the site converted into spacious park-like grounds; the glacis, too, is now covered with vineyards and gardens, which are externally bounded by a broad road; and beyond this road the adjacent ground is embellished with a profusion of villas, pavilions, and private gardens. The chief entrances are by nine large gates. In front of the north-eastern entrance is the monument erected by Frederick William II., king of Prussia, to the memory of the Prince of Hesse-Phillipsthal and his gallant followers. The Bockenheim gate, which is the western entrance, is built on the model of the temple of the wingless Victory at Athens; and the Upper-Main gate, on that of the porches of the Campus Militum at Pompeii. The Eschenheim gate, the north-western entrance, is the only specimen extant of the ancient gates; it is a lofty massive tower, crowned by five turrets, and is a fine specimen of the German architecture of the fourteenth century.

The population of the town of Frankfurt, in 1861, was 75,930, and of the suburbs, 11,588; total, 87,518. In 1884 the number of inhabitants had increased to 150,000. There are six large and fourteen minor squares or open spaces, and about 220 streets and lanes. The city has numerous places of worship. The right bank of the river is edged by a spacious quay, behind which lies an uninterrupted line of buildings. Frankfurt communicates by railway with Carlsruhe, Mainz, Wiesbaden, &c., and has a regular traffic with steam-packets on the Main. Two large fairs are held here annually.

The most remarkable building in the town is the Römer, or town-hall, an irregular structure, with lofty roofs in the old Frankish style. Under its roof is the Wahlzimmer, or Hall of Election, in which the electors and their representatives were wont to assemble and partly conduct the business of electing the emperors of Germany. Next to it is the Kaiser-saal, or Imperial Hall, where the emperor, upon his election, held his public dinner, at which he was waited upon by the counts and the high officers of the empire. There are niches in this hall which contain portraits of the emperors of Germany from Conrad to Leopold II. The Römer is situated on the western side of the Römerberg, an irregular open space or square, which has also much of historical interest attached to it.

The Saal Hof, a gloomy modern building, on the site of a palace erected in 822, is now used by the celebrated Conservatorium of Music; the Braunfels, used as a commercial exchange; the spacious palace of the Prince of Thurn and Taxis, where the German Parliament met from 1816 to 1866; the ancient house of the Teutonic Knights in Sachsenhausen; the Stone House, a fine remnant of the middle ages; the Fürsteneck, one of the oldest buildings in Frankfurt; the Städel Art Institute, to which Frankfurt is indebted for her high rank in the artistic world, containing drawings, engravings, casts, and pictures; the theatre and opera house, an exceedingly handsome building; the public library; the academy of arts and sciences, and many hospitals and asylums, are among the chief buildings of the city. Frankfurt contains a number of institutions devoted to science, art, and education. The old part of the town still consists for the most part of narrow and unattractive streets, but the whole place has been improved by the erection of many good houses in the principal streets and the adjoining suburbs.

The cathedral church of St. Bartholomew, a Gothic structure, begun in the time of the Carlovingian princes, but not finished till the fourteenth century, was burnt down in 1867, but has since been restored. Its tower is 312 feet in height. On the right of the grand choir was the chapel in which the electors accepted the German

emperor-elect as their sovereign, after he had been crowned and anointed at the high altar. Near the cathedral is a building for preserving the municipal archives, in which is preserved the famous "golden bull," the deed by which Charles IV., in 1356, settled the mode of election of the German emperors, fixed the number of electors at seven, and determined their rights of voting. At a short distance north of the town is the public cemetery, laid out like a pleasure-ground with shrubs; and adjoining it an equally well-arranged burial-place for the Jewish community. Dannecker's statue of "Ariadne" is in Bethman's museum, near the Freiburg gate.

With the exception of Sachsenhausen and its 10,000 inhabitants, who are principally agriculturists, gardeners, and day labourers, the citizens of Frankfurt derive their subsistence from commerce, money operations, and manufactures; it is a place of considerable transit for German and foreign produce. The chief articles of trade are wines, English, French, and Italian goods, Bavarian timber, German wools, colonial produce, and German manufactures; but its principal source of wealth is in extensive banking, commission, and funding transactions. The manufactures comprise carpets, table-covers, oil-cloth, cotton and silk fabrics, woollen yarns and stuffs, gold and silver articles, tobacco, playing cards, and printers' black; and it has many printing, stereotyping, and lithographic establishments.

Of the origin of the word Frankfurt little is known beyond the signification, "the ford of the Franks," which is nearly equivalent to the Latin *Trajectum Francorum.* The place appears to have been originally a Roman station, but did not attract much attention till the time of Charlemagne, who had a palace and held a council here in 794. Louis the Pious surrounded it with walls and ditches in 838. In the records of the middle ages Frankfurt is mentioned as one of the principal cities in the German Empire. A "golden bull" confirmed the privilege which Frankfurt had long enjoyed, of being the place of all imperial elections. The townsmen gradually increased their powers and possessions down to the treaty of Westphalia, which recognized all its immunities, and it was taken under the special protection of the empire by the imperial rescripts of 1682 and 1683. The Emperor Charles VII. resided here from 1742 to 1744, and the German diets were at that period transferred to Frankfurt from Ratisbon. Frankfurt was made a grand-duchy by Napoleon; but a resolution of the congress of Vienna in 1815 re-established the city of Frankfurt and its former territory as a free state, and from that time to 1866 it was the seat of the Germanic Diet. On the outbreak of the Seven Weeks' War, between Austria and Prussia, in the last-named year, the city was occupied by Prussian troops, and it now forms part of the additional territory then acquired by that kingdom.

The territory immediately around the walls of the city, on both sides of the Main, is quite level, and its soil, a deep sand covered with a crust of lava, is admirably adapted for the growth of corn, vegetables, the vine, and other fruits. The inhabitants of the villages are partially employed in manufacturing and mechanical pursuits within the walls of the city itself; but the most lucrative occupation they follow is that of carriers through many states of Germany.

The Jews are unusually numerous in the city, and now occupy some of the finest mansions in it and in the environs. They were formerly much oppressed, and compelled for centuries to live in a dark unwholesome quarter called Judengasse, or Jews' Lane, from which most of the poor houses have been removed.

Frankfurt was the birthplace of Goethe, who was born on the 28th August, 1749. Amschel Rothschild, ancestor of the banking family of that name now spread all over Europe, was born in a wretched dwelling in the Jews' Lane alluded to above, in 1772, and died in 1812 worth more than a million sterling.

FRANK'FURT-ON-THE-ODER, the largest town of the Prussian province of Brandenburg, after Berlin and Potsdam, is pleasantly situated on the left bank of the Oder, and surrounded by vine-clad heights and gardens, at a distance of about 50 miles E.S.E. by rail from Berlin. It consists of the town proper, surrounded by walls and ditches, and of three suburbs on the left bank, and of another suburb on the right bank of the river, which is here crossed by a wooden bridge about 290 yards long. It is built with considerable regularity, four spacious streets traversing it nearly in parallel lines. It is the seat of a superior court of appeal and of other courts and public offices, and contains numerous churches, of which the Marien, or Oberkirche, of the thirteenth century, is most deserving of notice, a Roman Catholic chapel, synagogue, town-house built in 1617, a gymnasium, burgher and numerous other schools, theatre, a house of correction, an orphan and two other hospitals. The university which Frankfurt possessed from an early period was transferred to Breslau in 1816. The manufactures consist of woollen and linen cloth, silks, hosiery, gloves, leather, delf and common earthenware, wax, sugar, and brandy; and the trade, general and transit, is extensive both by land and water, particularly the latter, there being about 2000 vessels which annually pass the town. There are also three important annual fairs, much frequented by dealers from Poland. The town was founded by the Wends and annexed to Brandenburg in 1250. In the neighbourhood, near Kunersdorf, a great defeat was suffered by the Prussians, under Frederick the Great, at the hands of the united army of the Austrians and Russians. But the advantage was lost by delay. Frankfurt possesses a bathing establishment, with chalybeate springs and vapour and sulphur baths. The population in 1882 was 51,147.

FRANK'INCENSE, a gum-resin obtained by making incisions in certain trees belonging to the genus BOSWELLIA. There was great uncertainty about the true source of frankincense or olibanum until a paper was published in 1871 in the *Transactions of the Linnean Society*, by Dr. George Birdwood, embodying his researches. He states that there are three species which yield it—namely, *Boswellia Frereana*, *Boswellia Bhau-Dajiana*, and *Boswellia Carterii.* [See BOTANY, Plate I., fig. 3.] These trees are natives of the hills in the Somali country of East Africa, and in the district of Hadramaut of South Arabia. They are described as growing directly out of hard limestone rocks. The resin is obtained by making a deep incision in the tree, and stripping off the bark for about 5 inches below. The sap exudes and gradually hardens, when the incision is made deeper. In about three months' time the resin has sufficiently hardened to remove. *Boswellia thurifera*, a native of India, and *Boswellia papyrifera*, a native of Abyssinia, yield a resin, but much inferior to the true frankincense.

FRANK'ING LETTERS, a privilege formerly enjoyed by peers and members of the House of Commons, and many official persons, of sending and receiving letters duty free. Originally nothing more was required than that the peer or M.P. should write his name on the corner of the envelope, leaving the address to be filled in by other hands. This, however, was found to have led to the extensive sale of franks, and accordingly a further proviso was passed, insisting that the entire address should be written by the franker. Each person privileged to frank was entitled to send ten letters every day, and to receive fifteen, free. It was abolished on the introduction of the penny postage.

Formerly the practice of franking prevailed extensively in the United States—the privilege being enjoyed by

members of Congress, the president and cabinet ministers, postmasters, and numerons other officials; in addition to which the mails carried a considerable quantity of newspaper matter free of charge. The whole system of franking, however, was abolished throughout the United States in June, 1873.

FRANK'LIN (Frankelein) was the name of the mediæval farmer of England holding direct from the crown, and not from any feudal lord. He was thus a *frank* or free man. Chaucer describes him as he was in the time of Edward III.:—

> "Withoulé bake mete was nevere his hons
> Of flessch and fissch, and that so plentevons
> Itit snewede (It snowed) in his hous of mete and dryoke
> Of allé deyntees (dainties) that men cowdé thynke."

He was thus held up as the most hospitable of men, well to do, full of generous cheer and kindly greeting; often knight of the shire, or else sheriff (Prologue to the "Canterbury Tales"). In old records of precedence he ranks next after the barons. Shakspeare shows us the graver franklin of Elizabeth's day, rather humbler in rank also, as times had changed. Thus in the first part of "Henry IV." (Act ii. scene 1) the scapegrace prince is told of the arrival of a suitable victim for his plunder, "a franklin from the wild (weald) of Kent" with 300 marks of gold. But this was only a survival of the name; the franklin as a special class of society ceased to exist, of course, with the cessation of the feudal system; and in Elizabeth's day that was, in all except the name, a thing of the past.

FRANKLIN, BENJAMIN, born at Boston in New England, 6th January, 1706, was the son of a tallow-chandler in humble circumstances, but intelligent and strong-minded. Benjamin was apprenticed to his brother, a printer at Boston; but the two could not agree, and Benjamin took advantage of the fact that his indentures had been cancelled by mutual agreement for special private reasons, and left him. It is himself who relates, in a most honourable spirit, this dishonourable act. Prevented by his brother from finding employment in Boston, he went to Philadelphia in 1723, and worked there for a year and a half with Keimer, a printer. He went to England to purchase printing material in 1725, on a deceptive promise of assistance to set up as a master printer, and was compelled to work as a journeyman printer in London. His interesting account of this period is as widely as it is deservedly known. In 1726 he returned to Philadelphia as clerk to a merchant; but the latter died in 1727, and Franklin returned to his old master, Keimer. Friends and credit enabled him to establish himself on his own account in 1729. The following year he married. He now engaged in literature, edited a newspaper, advocated paper currency, and in 1732 projected "Poor Richard's Almanack," containing the well-known maxims, which, collected under the title "The Way to Wealth," obtained uncommon popularity, and have been translated into various languages.

In 1732 he set on foot the first public library of Philadelphia; in 1738 he established the first association for extinguishing fires, and at a later period the first fire-insurance company; in 1749 he raised subscriptions for the foundation of a public academy, the origin of the present University of Pennsylvania; in 1752 he raised subscriptions and procured an auxiliary grant from the legislature to establish the first hospital in Philadelphia; and in 1754 he proposed a plan for the union of the American provinces against invasion, in which a germ of the future Union may be found.

As a philosopher his name is indissolubly linked with the history of electricity, in which he was one of the most active, patient, and successful experimenters; and his industry was rewarded in 1752 by the discovery of the identity of electricity and lightning. He immediately proceeded to turn his discovery to account by publishing a plan for defending houses from lightning by the use of pointed conductors.

The increasing estimation in which he was held was manifested in his successive appointments to different offices. In 1736 he was made clerk to the General Assembly of Pennsylvania; in 1737, postmaster of Philadelphia; in 1747 he was elected as one of the representatives of Philadelphia in the Assembly; in 1753 he was appointed deputy postmaster-general for the British colonies. As a member of Assembly he was soon looked up to as the head of the opposition, and to him have been attributed many of the spirited replies of the Assembly to the messages of the governors. He spoke but seldom. His speeches often consisted of a single sentence, or of a well-told and pointed story. His manner was plain and mild. And thus, with his penetrating and solid judgment, he was able to confound the most eloquent and subtle of his adversaries, to confirm the opinion of his friends, and to make converts of the unprejudiced among those who were his opponents.

He was sent to England in 1757, on the part of the Assembly, to manage a controversy before the Privy Council; and was successful in obtaining a decision that the estates of the proprietaries, Penn's representatives, ought to pay their fair proportion of the public burdens. His conduct was so highly approved that Massachusetts, Maryland, and Georgia severally appointed him their English agent. By this time his name was well known to European philosophers. He was chosen a member of the Royal Society of London, and of several foreign scientific bodies at a later period; he was also elected a foreign associate of the French Académie des Sciences, and the universities of Oxford, Edinburgh, and St. Andrews admitted him to the degree of D.C.L. On his return to America in 1762 he received the thanks of the Assembly. The friends of the proprietaries had influence enough to prevent his election in 1764. On the meeting of the Assembly, however, he was reappointed provincial agent in England. He was a warm opponent of the Stamp Act, and was examined at the bar of the House of Commons in 1766, when the repeal of that offensive measure was proposed. He was in consequence deprived of his postmastership, and treated with great roughness by the English ministry.

In 1775, having lost all expectation of bringing about a reconciliation, he returned to Philadelphia, and the day after he landed was elected a delegate to the Congress then assembled in that city. During that and the following year he was sent on a fruitless mission to persuade the Canadians to join in the insurrection. Towards the end of 1776 he was sent to France, where in conjunction with his brother minister, Silas Deane, he succeeded in inducing the French government to form an offensive and defensive alliance with the United States, 6th February, 1778. In 1785 he was recalled, at his own wish, and was succeeded by Jefferson. Soon after his return he was chosen member, then president, of the supreme executive council for the city of Philadelphia, and in 1787 delegate for the state of Pennsylvania, in the convention appointed to revise and amend the Articles of Union.

After enjoying through a long life an unusual share of health, Franklin was compelled in 1788 to quit public life by the infirmities of age. His last public act was to sign, as president of the Abolition Society, a memorial to Congress, dated 12th February, 1789, praying them to exert the full extent of power vested in them by the constitution in discouraging the traffic in slaves. He died 17th April 1790, aged eighty-four.

FRANKLIN, SIR JOHN, the Arctic discoverer, was born on the 16th April, 1786, at Spilsby, in Lincolnshire. His father was extremely anxious that he should enter the church, and he purchased an advowson for him, intending

that he should complete his education at a university. His inclination, however, was to go to sea. Hoping, though hardly expecting, to make a sea-life repugnant to his son, his father sent him in a small trading ship to Lisbon; but though the discomforts of the voyage were great, the boy's love for a nautical life overcame every consideration. Accordingly his father gave way, and he was entered as midshipman on board the *Polyphemus*, at the age of fourteen, where he served in the battle of Copenhagen in 1801. On the return of the *Polyphemus* to England he was appointed to the *Investigator*, commanded by his cousin, Captain Flinders, and commissioned for a voyage of discovery to Australia. Captain Flinders and his officers were afterwards transferred to the *Porpoise*, and left Australia with the intention of returning to England. The *Porpoise*, and her consort the *Cato*, were wrecked on the 18th August, 1803. On arriving in England Franklin was immediately appointed to the *Bellerophon*, Captain Laing, and was signal midshipman in the memorable battle of Trafalgar. He was now promoted, and as lieutenant served for six years in the *Bedford*; was present at the blockade of Flushing, and at the disastrous attack on New Orleans. On this occasion he commanded the *Bedford* gun-boats, and received a slight wound. Franklin then obtained an appointment in the Arctic expedition commanded by Captain Buchan, the object of which was to penetrate and explore the supposed Polar Sea. The expedition, consisting of the *Dorothea* and *Trent*, sailed in 1818. During a violent storm in lat. 80° 30′, the *Dorothea* became disabled, and the ships returned to England. In 1819 he was despatched by the government to Hudson Bay, with orders to make his way thence to the Arctic Sea, and survey as much of the coast as possible. In the course of this expedition, which lasted three years and a half, he travelled nearly 6000 miles, under circumstances of such extreme hardship and privation that more than half his companions died. The exploration, however, added much to scientific and geographical knowledge; and on his return Franklin was made post-captain, and elected a fellow of the Royal Society. In 1823 he married Eleanor, youngest daughter of William Porden, Esq. In 1825 he started on his second land expedition. Descending the Mackenzie River to the sea, he traced the North American coast from the Coppermine River to nearly the 150th meridian, and approached to within 160 miles of the most easterly point attained by Captain Beechy, who had passed into the Arctic Sea from Behring's Straits. On his return to England he was knighted, and received numerous honours. His first wife having died in 1825, Sir John married in 1828 Jane, second daughter of John Griffin, Esq. He took an active part in the Greek war of liberation; and after a few years' rest, an application for employment in the colonies led Lord Glenelg to offer him the governorship of Antigua, and subsequently of Van Diemen's Land. Franklin accepted the latter, on condition that if war broke out he might be allowed to resign his appointment if offered the command of a ship.

In 1844 Franklin returned to England, when it was decided that one more attempt should be made to discover the north-west passage. This expedition consisted of the ships *Erebus* and *Terror*, lately returned from Antarctic service. They were provided with small screw engines, and officered and manned by persons experienced in Arctic service. The expedition left England on the 26th May, 1845. Franklin's instructions were to pass through Lancaster Sound as far as Cape Walker, and then make his way, to the best of his ability, to Behring's Straits. The *Erebus* and *Terror* were last seen on the 26th July, 1845, in Baffin's Bay—all well; and letters of that date received from Franklin and his officers are full of hope and anticipations of success. No further tidings of the explorers having been received, in the autumn of 1847 it was determined to equip an expedition in search of them. This sailed in 1848, and from that period until 1857 expedition after expedition was despatched. The Admiralty at last announced officially that the search was closed, but Lady Franklin resolved on making one more attempt to ascertain her husband's fate. She purchased the screw steamer yacht *Fox*, and having equipped it in the most efficient manner, the command was intrusted to Sir Leopold M'Clintock. The expedition left Aberdeen on the 2nd July, 1857. In the spring of 1859 the search was commenced. On the north-west shore of King William Land a record was discovered announcing that the *Erebus* and *Terror* had been abandoned, that Sir John Franklin died on the 11th June, 1847, and that out of 134 persons originally composing the expedition, the survivors, amounting to 105 officers and men, purposed endeavouring to make their way to the American continent by the Fish River. The discovery of skeletons, a boat, and other relics leave no doubt that these also perished. Though the expedition ended thus fatally, it cannot be termed a failure, for by attaining the locality where the *Erebus* and *Terror* were abandoned it reached within a few miles of the farthest spot touched by earlier explorers starting from the westward; thus it is no mere metaphor which ascribes to Franklin the discovery of the north-west passage. The interest felt in the fate of this expedition is by no means yet extinct, and as late as 1878 another search party was sent out from America on the strength of rumours of some still existing records. Thus died Sir John Franklin, not only in the execution of his duty, but in the fulness of success. A handsome statue was erected to his memory in London in 1866, the expense having been defrayed by a parliamentary vote.

FRANK-PLEDGE, the Norman form of the old Saxon custom of *frithborh*, which was in use at a very early period. It seems to have originated in an accused person finding bail for his appearance at his trial, and gradually to have extended into a demand from every freeman for a pledge for his good behaviour. It was in the Norman times exacted from every free-born man (excepting clerks, &c.) at the age of fourteen. The custom was so rigidly observed that at every county court the sheriffs called upon all those persons who had arrived at the proper age to take the accessary oaths, and settle themselves in one tithing or another; and this branch of the sheriff's authority was called "the view of frank-pledge" (*visus franci plegii*). Sometimes a certain number of neighbours became bound for one another, and were accountable for the appearance of their pledge when called upon. Its origin is assigned to the Lombards.

FRANKS, or the "Free Folk," was a general name assumed by many Teutonic tribes pressing upon the north-western parts of the Roman Empire. These tribes, first known by their separate names Sigambri, Chatti, &c., were collectively called Franks when in the third century they passed the Rhine near its mouth and established themselves in what we now call the Netherlands. Later they divided into two main groups, slightly distinguished by codes of laws, most fortunately still existing. These were the *Lex Salica* of the Salian Franks, who dwelt by the sea (*Sala* being the Yssel), and the *Lex Ripuaria* of the Ripuarian Franks, who dwelt by the banks (*ripæ*) of the river, inland. [See SALIC LAW.] The first were the most important, and it was under Hlodowig or Chlodwig (Clovis), a chief of the Merwing family, that the Salian Franks descended upon the Gauls in 486 to found the Frankish dominion, as described in the article FRANCE. The conquest of Chlodwig was made the more complete as when converted he chanced to choose the Roman Catholic faith, whereas all the other converted Teutonic kings were Arians. He was thus enabled, under the guise of religion and with the help and approval of Rome, to wrest their conquests

from them. The Franks have left their name in *France* and in *Franconia*, the one a part of Gaul, the other of Germany. Both alike are called *Francia* in Latin.

The name of the "free folk" was well deserved by these bold and savage warriors. They were all equals, acknowledging no master. Each man was a free landholder, his own lord, priest, and judge, the tribe being ruled by the open assembly of all its members. If wrong was done, not the individual wrongdoer but his family was held responsible; and every injury carried with it its special fine. Thus each member of a family felt bound not to disgrace it, and on the other hand the family kept guard over its members lest the whole should suffer for the fault of one. When this occurred the criminal was judged, not by his tribe, but by his family, and what personal punishment he received was at their hands alone. Each tribe dwelt within its *mark* or march, or border of waste forest land, purposely left barren as a protection, and crossed by strangers at their deadly peril. While all the tribesmen were equally free there were some families which by greater wealth or skill attained a hereditary pre-eminence. These were the *eorls*, and from them the chiefs of the tribe were chosen. They had to declare and settle the customs of the tribe, and to record and promulgate its laws. It was only in war time that these free Franks submitted to control, and then they chose a *heretog* or leader for the time, whose power expired with the need for it. But as with Chlodwig and the Franks in their war on Gaul, so also with the kindred folk of the Saxons when under the leadership of Hengest and Horsa they descended on Britain, astute and powerful princes soon found means of perpetuating their sovereignty. Chlodwig even received the consulship from the hands of the emperors of the East, and thus ruled Gaul, or pretended to rule it, as viceroy for the court of Constantinople.

Till the conversion of Chlodwig the Franks worshipped Tiw (or Teu, whence their name of Teutons, *Teu* being manifestly the same word as the Greek *Zeus* or the Latin *Deus*), All-father Odin, Thor, Freya, and the other deities of the Norse mythology whose legends are preserved for us in the two Eddas. This, the common faith of the Teutonic peoples, leaves its traces here and there among us; as in the Sun's day, Moon's day, Teu's day, Oden or Woden's day, Thor's day, Freya's day, Sæter's day of our Teutonic ancestors. The English lay round Elbe eastward of the Franks, who lay on the Rhine, but in fundamentals they were a kindred folk. The first, however, dispossessed the Britons from Britain, and occupied the land in their stead. Britain became England by a repeopling of its soil. The Franks, on the other hand, conquered Gaul and held it subject, and though Gaul took the name of France it never became Frank. The influence of the Franks on its speech was slight [see French Language], and even the Frank domination itself only lasted 500 years. See France.

FRANZ-JOSEF LAND, an archipelago of the Arctic Ocean, north of Nova-Zembla, of about the same extent as Spitzbergen, extending from lat. 80° to 83° N., and from lon. 49° to 61° E. It consists of several large masses of land, of which the most extensive is Welczeckland in the E. and Zichyland in the W., divided from one another by Austria Sound. Other islands are M'Clintock, Hall, and Salm, south of these two; and Oscar, Petermannland, and Prince Rudolf, north of them. The surface is generally elevated, and rocky when free of ice. In Zichyland there is a peak 5000 feet in height; many others rise to 2000 and 3000 feet. The prevailing rocks are dolerite, of igneous plutonic origin, and a tertiary carbonaceous sandstone; but the associated coal beds are not so rich as in the same formation in Greenland and Disco. In Austria Sound the rise of tide is 2 feet. The group was discovered in 1873 by an Austro-Hungarian expedition which wintered in lat. 79° 51′ N. Here an extreme temperature of *minus* 46·5° Fahr. was experienced; the sun disappeared wholly on the 22nd of October, and reappeared on the 24th of February, there being at each time a week's twilight.

FRASCA'TI, a town of the Campagna, situated on the slope of a hill 12 miles E.S.E. from Rome. It has about 7500 inhabitants. On the summit of the hill, about 2 miles above Frascati, are the ruins of ancient *Tusculum*, which comprise an amphitheatre, a theatre, an immense hall, supposed to have been attached to baths, fountains, &c. Tusculum was one of the most ancient cities of Italy, its foundation being ascribed to Telegonus, the son of Circe. It was strong as well by its position as by the walls by which it was surrounded, portions of which still exist. It was also one of the most faithful of the allies of Rome, and successfully resisted an attack by Hannibal. It was the birthplace of Cato. The top of the hill on which Tusculum was built was surmounted by a citadel, now wholly destroyed. After the destruction of this town by the Romans, in 1191, the inhabitants built themselves huts on the lower slope of the hill towards Rome, and covered them with *frasche*, boughs of trees, from which the modern town has taken its name. It has some good buildings, and is a bishop's see. The air is wholesome, the place being above the region of the malaria, and the country around is planted with fine trees. There are also numerous gardens in the vicinity, and from this circumstance the name Frascatese is used in a sense almost synonymous with "garden-girl." But the remains of ancient buildings, among others the so-called Cicero's Tusculan Villa, and its splendid modern villas, among which may be specially noted the Villa Ruffinella, formerly the property of Lucien Bonaparte, who in 1818 was attacked here and plundered by robbers, form the great attraction of Frascati, it being a place of resort of the Roman nobility and cardinals in the summer and autumn.

FRASER RIVER, the principal stream in British Columbia, forming what may be called the great artery of the country. It takes its rise in the vicinity of the Rocky Mountains, about 53° N. lat. and 118° 40′ W. lon. It flows in a north-west direction to about 54° 25′ N., then turns completely round, unites with a large affluent, the Stuart River, and flows directly south. The Stuart takes its rise from a number of lakes lying between 54° and 55° N. and 124° 50′ W. At its junction with the Fraser stands Fort George. The Fraser flows from its source to this point over a distance, including all its windings, of 260 miles; the length of the Stuart is 200 miles. As the volume of water formed by their united currents flows south they are joined by a number of tributaries, the chief of which is the Thomson, which unites with it about 50° 12′ N. Some distance south of this it turns round and flows in a westerly direction, and finally falls into the Gulf of Georgia, about 6 miles north of the boundary line between the British and United States territory. Its whole length is about 740 miles. The principal tributaries, besides those mentioned above, are the Harrison, the Pitt, the Anderson, and the Quesnel. Between June and August the melting of the snow causes the river to rise so rapidly that after a distance of about 30 miles from its mouth—up to which point it is broad, deep, and placid—it requires a very powerful steamer to stem the current. At the same period large numbers of uprooted trees are brought down, and becoming imbedded in the shallower places form dangerous obstructions to navigation. Most of the land adjacent to the river is clothed with fine trees. For a distance of about 70 miles from its mouth the banks are low and liable to be overflowed in the spring and summer.

FRASE'RA, a genus of plants belonging to the order Gentianeæ, named after John Fraser, a collector of North American plants.

Frasera carolinensis is indigenous in the swamps of the Carolinas, and is found on the borders of lakes in Pennsylvania and New York. The whole plant has a very stately appearance. The root yields a powerful bitter, nearly as pure as that of quassia, and wholly destitute of aroma. It is fully equal in its medicinal effects to gentian, and when fresh is said to be emetic and cathartic. The roots have been imported into Europe as a sort of columba, and hence have acquired the name of American Calumba.

Frasera contains seven species, all natives of North America. The genus approaches so near in character to Swertia, that it is difficult to separate them, but Frasera has a subulate style. Each of the segments of the corolla has a gland protected by a fringed scale.

FRA'SERBURGH, a seaport, town, and municipal burgh of Scotland, on the north coast of Aberdeen, 47 miles N. of Aberdeen, and 590 from London on the Great North of Scotland Railway. The town is built on the western side of a small bay, and consists of straight and well-built streets crossing each other at right angles. The houses are substantial, and many of them of modern erection. The population in 1881 was 7596. There are a town-hall, academy, and hospital. The market-cross was restored in 1853. The parish church is in the middle of the town, and there are a Free church and Episcopalian and Independent chapels. The harbour, since it has been improved by the widening of the piers and the construction of breakwaters, is one of the best on the east coast. It has a depth of 6 feet at low water and 20 feet at high water of spring tides, and has now an area of 6 acres with good anchorage. The town is one of the chief stations of the Aberdeen herring fishery, and has from 500 to 700 boats engaged in it during the season (July and August). The town and harbour have existed for more than two centuries, the former having been erected into a burgh of regality in 1618, called Fraserburgh, in honour of Sir Alexander Fraser of Philorth, who obtained the charter.

FRATICEL'LI was the name of the more rigid among the Franciscan friars. *Fraticello* is the diminutive of *frater* (brother, friar); the Fraticelli, then, were the "little brethren." In the wealth and power to which the Franciscans had arisen the real rule of St. Francis, with its austerity, its poverty, and its humiliation, was no longer observable. Pope after pope issued explanatory briefs enabling Franciscans to relax the original rule and read it in the spirit of another age. Against this the more truthful among them rebelled. They came to be known as the Fraticelli *par excellence*, though this had originally been a name of affection for the whole body of brothers of St. Francis. Dissatisfied with the temporizing conduct of the popes, they not only refused to receive the offered relaxations, but they necessarily went further, and formed a little nucleus of revolt within the church; for it was manifestly impossible to regard as the true vicars of Christ men who from the papal chair would palliate the non-fulfilment of plainly-spoken vows to God. In vain Gregory IX. and other popes endeavoured to win over the resolute reformers: they stood to the old ways. Pope Celestine V., who was himself one of the austerest of monks before his elevation to the papal throne (from which he afterwards retired, unable to bear the weight of intrigue which gathered round whomsoever sat thereon), was also founder of the rigid order of monks who after his death were called in his honour Celestines. He naturally looked with favour on the Fraticelli, and gave them permission to found a separate rule within the great order, seeing that he could not well rescind the relaxations of his predecessors. This was done, and the Fraticelli soon absorbed the equally rigid Celestines; but Boniface VIII., who succeeded Celestine on his abdication, attempted to overturn this good work of his, as he overturned many more, and suppressed the new suborder most rigorously (1300). He did not entirely succeed. They retreated to the Apennines, and lived among the peaks and forests, enjoying undisturbed the pride of beggary, leaving the sumptuous convents, the great learning, and the splendid worship to their weaker brethren. They even originated a daring prophecy, that as Judaism had been the religion of the Father, and Christianity that of the Son, so there was now to come a new dispensation, that of the Holy Ghost. They begged sufficient for a meal, which they ate hurriedly, never saving a morsel—for they denounced saving as a sinful mistrust of Providence. Wild sects akin to the Fraticelli rose here and there. A certain Wilhelmina appeared in 1281, declaring that she was the Holy Ghost himself, whose birth was announced by Raphael beforehand to her mother, Constance of Bohemia, as that of Christ had been to Mary by Gabriel. Before her death she named a certain Mayfreda her vicar, and in fact in every way burlesqued the Catholic Church on the principles of the new dispensation of the Fraticelli. She died in the odour of sanctity, and her bones worked miracles. Mayfreda officiated as vicar till 1301, probably concealing the doctrines she had received; for the church suddenly seemed to wake up, Mayfreda and her assistant were burned at the stake, and the bones of the departed saint were scattered to the winds.

Later by a few years came the more serious movement of Dolcino of Novara, who preached the doctrines of the Fraticelli, and added further to them the claim of poverty for the whole church, and the expectation that the Holy Ghost would come as pope. In vain Clement V. issued his bull for their suppression in 1305; the Fraticelli and kindred spirits flocked to Dolcino and his beautiful and high-born friend, Margarita, on the flanks of Mount Volnara, in the Val Sesia, among the southern slopes of the Alps. Here a considerable community gathered together, and from their mountain stronghold reduced to submission the whole of that fertile valley. Armed with the bull of the pope, Bishop Rainieri advanced to the reconquest of his diocese. The insurgents were hunted like wild beasts, yet would they not recant; they lived among the snows and suffered slow starvation and the rigours of an Alpine winter. The latter did its work, and a final onslaught in spring found them too weak to resist. They were worn almost to shadows. Notwithstanding the long fight and the worse privations 1000 or more remained, and these were massacred to a soul; some were offered their life, but not one would recant as its price. Margarita was burned by a slow fire in the presence of Dolcino, and Dolcino himself was torn to pieces alive by red-hot pincers with every circumstance of barbarity.

John XXII., worldly, avaricious, and heir to the vast treasures of Clement, ascended the throne at this moment. The Fraticelli declared loudly that so much tyranny, faithlessness, and avarice could not last, that the pope and his church must surely fall, and that speedily. They declared that besides this condemned church a true church was silently growing up, of which they formed the nucleus, "spiritual, frugal, without uncleanness, admirable in virtue, clothed in poverty, ruled by saints." The crowds who flocked to these teachings alarmed John XXII. Bull after bull was issued, and the fearful Inquisition set to work. French convents had turned Fraticellist *en masse;* their monks were seized, and boldly protesting to the last some were burned at the stake at Marseilles. The prisons were crowded with the remainder, batches of whom were brought to the stake at intervals. But since the great claim of the Fraticelli was to carry out the true rule of St. Francis, and many of them suffered for this alone, it was felt that the pope had gone too far. A full chapter of the whole order was held at Perugia, and Michael di Cesena, the general, presided over it. Decisions of previous popes and councils were pleaded, and it was roundly asserted that, so far as the poverty of Christ and the church was concerned, the

Fraticelli held the true faith. John did not scruple to denounce even this great council as heretical, and certainly made a good point when he taunted the order with its past possessions, held by the transparent fiction that they belonged, not to the Franciscans, but to the pope. He announced that he should act on this as an admitted fact, and resume the wealth thus belonging to St. Peter. Enraged at the threat, the chapter publicly arraigned the Avignon pope as himself heretical, and Di Cesena was bold enough to denounce him to his face in the name of the Franciscans. The whole strength of the church was put forth, and Di Cesena was deposed in favour of the less rigid Bertrand di Torre as general. The comfortable well-being of the order resting upon papal decrees, it was felt by all who had not the martyr's spirit that to attack the church as they had been doing was to covet the misery and wretchedness to which their vows bound them, but for which they had no mind. The agitation therefore gradually ceased. A few enthusiasts continued to haunt the Apennines for a century or so longer, but the order in general abandoned the enthusiastic position of Perugia as quickly as it had taken it up.

FRAUD may be defined as the gain of an advantage to another's detriment by deceitful or unfair means. Fraud is wrongful in the eye of the law, and actionable if damage result therefrom, and it constitutes a ground for setting aside a transaction at the option of the person prejudiced by it, or for recovery of damages. Its essential element is intentional misrepresentation involving damage, for an action cannot be sustained merely on the ground of a lie, and without damage being shown. The most important application of the law respecting fraud is in reference to contracts, and it may be taken as a general principle accepted among all civilized nations that obligations are invalidated by fraud. In English law a person who has entered into and been injured by a contract that is vitiated by fraud, has the option of rescinding the agreement if he chooses, or of affirming it, and of requiring the other party to place him in the same position as if the false statement had in fact been true. Innocent misrepresentation, even where it forms a *condition* or *warranty*, will be sufficient to void a contract, and the studied concealment of a flaw or defect will have the same effect. In making a bargain, however, the buyer is not bound to give the seller information; thus if a man buys an estate knowing there are valuable minerals under the surface, a circumstance of which the seller is in ignorance, such contract will be valid, inasmuch as it is the business of the *seller* to ascertain the value of that he has to dispose of.

The English courts have refrained from any exact definition of fraud, lest their power should be limited in dealing with the complex questions which continually arise, but their decisions are largely guided by the important Statute of Frauds (29 Charles II. c. 3); its supplement, known as Lord Tenterden's Act (9 Geo. IV. c. 14); and the Act 24 & 25 Vict. c. 96, ss. 75–90. Concerning the first of these Acts its object is stated to be "the prevention of frauds and perjuries," and its effect is to make writing essential to the validity of certain transactions. By the fourth section of this Act it is provided that no action shall be brought on the contracts therein mentioned unless the agreement, or some note or memorandum thereof, shall be in writing, and signed by the party to be charged therewith, or some other person thereunto by him lawfully authorized. Among the contracts thus referred to are such agreements as are made upon consideration of marriage; all contracts or sales of lands, tenements, or hereditaments, or any interest in or concerning them; and any agreement that is not to be performed within the space of one year from the making thereof. By the seventeenth section of the Act no contract for the sale of goods for the price of £10 or upwards shall be good unless the buyer accept part or give something in part payment, or some memorandum thereof be made to be signed by the parties to be charged or their agents. By Lord Tenterden's Act it was further enacted that acknowledgments of debts that are statute-barred; representations as to a person's character or solvency, made in order to obtain him credit, &c.; and executory contracts for the sale of goods, must be made in writing in order to be actionable. The Act 24 & 25 Vict. c. 96 enacts that "whoever shall by any false pretence obtain from any other person any chattel, money, or valuable security, with intent to defraud, shall be guilty of a misdemeanour."

Though the Statute of Frauds and other English enactments do not apply to Scotland, yet the law applicable to fraud may be taken as substantially the same in both countries. Technical differences may be traced, but they cannot be noticed here.

FRAUN'HOFER, JOSEPH VON, was born at Straubing, in Bavaria, in 1787. He soon showed extraordinary skill as an optician, and set up at Munich in 1819 a manufactory of lenses and prisms of a delicacy and truth not before attained. Many practical improvements in the lenses of telescopes and microscopes are due to Fraunhofer. By the help of the advance in accuracy thus gained he was able about the year 1814 to perceive more clearly certain transverse dark lines cutting the solar spectrum and always appearing in exactly the same position, to which the English physicist, Wollaston, had already called attention. But where Wollaston with his imperfect instruments could only see a few of these transverse dark lines, Fraunhofer with his more perfect prisms was able to count no less than 576. These he mapped out very clearly, indicating their position by the shade of colour they crossed, and naming the most prominent by letters. Thus D indicates a strong double line in the orange yellow (which we now know to be the line due to the absorption of sodium). Fraunhofer was careful to test by many observations the doubt that these "fixed lines," as he called them, might be in his prisms, or might be limited to direct sunlight. But he found them with every kind of prism and with every kind of sunlight; sun, moon, planets, clouds, &c., gave the same peculiarities. The fixed stars, however, showed spectra with different lines. The explanation of "Fraunhofer's lines," as they are called (though "Wollaston's lines" would seem the more accurate expression), was never reached by their careful observer. That was reserved for Kirchhoff in 1859, and is fully given in the article SPECTRUM. Fraunhofer had only got as far as proclaiming that the double line D occurred in the solar spectrum in exactly the same position as the double bright line which forms the sole spectrum of the metal sodium when flaming in the form of vapour. Glowing gases, he had discovered, do not give the rainbow-tinted spectrum of the sun and of bodies at white heat, but only fragments of such a spectrum, consisting of bright bands now of this colour and now of that, according to the gas observed. But it was upon the hint of this exceedingly delicate observation of Fraunhofer's that Kirchhoff's investigation was based. Fraunhofer died in 1826.

FRAX'IN or **PAVIIN,** a fluorescent substance from ash-tree bark (*Fraxinus excelsior*), and found also associated with esculin in horse-chestnut bark. It crystallizes in colourless needles, and has no odour, but a bitter astringent taste. It is slightly soluble in cold, very soluble in boiling water. It is soluble in hot alcohol, but insoluble in ether. The solution gives a strong blue fluorescence, which is heightened by alkalies but destroyed by acids. It melts at 320° C. The formula is $C_{42}H_{46}O_{27}$. It is a glucoside, and is decomposed by dilute sulphuric acid into glucose and fraxelin ($C_{15}H_{12}O_8$).

FRAXINEL'LA (*Dictamnus Fraxinella*) is a plant often grown in gardens for the sake of its pretty rose-

coloured flowers and its fragrant leaves. The stem is not more than 2 or 3 feet high, with a few compound leaves below, and a raceme of fifteen or twenty flowers above. The flower-stalk and the outer parts of the flowers are covered with resinous glands. These glands are fully developed only when the flowers are fading, and at this time, in hot weather, exhale such a quantity of volatile oil that if a light is brought near a flash of flame envelops for a second the whole inflorescence. This was first noticed by a daughter of Linnæus.

Dictamnus contains only one species, a native of South Europe and Central and Northern Asia. It belongs to the order RUTACEÆ, and is nearly allied to Rue (Ruta). There are five unequal petals, ten stamens bending downwards, and a shortly-stalked ovary.

FREDERICK I., EMPEROR OF GERMANY. See BARBAROSSA.

FREDERICK II., Emperor of Germany. On the death of Frederick I. (Barbarossa), the Swabian Emperor of Germany, he was succeeded by his son Henry, who reigned only eight years, leaving a son Frederick, a child of four years of age, who had been created King of the Romans when in his cradle. Frederick was very carefully educated by his mother, Constance of Sicily, and acquired a degree of learning very extraordinary at that age. His hereditary dominions consisted of the kingdoms of Naples and Sicily, the duchy of Swabia, and other territories in Germany.

Till the year 1209, when Frederick took upon himself the government of Lower Italy and Sicily, he was under the guardianship of Innocent III. In 1210, the Emperor Otho being excommunicated by the pope, Frederick, then fourteen years of age, was declared emperor by a considerable number of the German princes; but it was not till some years afterwards, on the retreat and death of Otho, that he became peaceably possessor of the imperial throne, and was crowned at Aix-la Chapelle in 1215.

The events of his reign, for the most part, group themselves into two broad divisions—the one connected with his unremitting endeavours to make himself master of the whole of Italy and reduce the pope simply to the first spiritual dignitary of Christendom, the other connected with the war for the recovery of the Holy Land. He endeavoured in 1227 to obtain the Lombard crown, but the Milanese refused, reconstituted their old league with fifteen cities, and stopped all communication with Germany. They were put under the ban of the empire. Both parties appealed to the pope (Honorius III.) Honorius had gradually changed towards the brilliant Frederick. From his declaration of 1220, "Never did pope love emperor as I my son Frederick," and his joyful planning of the crusade which Frederick had sworn to undertake, he had drifted very far indeed. The emperor on his side had grown more and more indignant at the assumption of supreme authority put forward in insinuation and innuendo by the pope. The arbitration was couched in so haughty a manner (though its terms seem fair) that the quarrel was evidently no longer to be delayed. At this moment Honorius died; and his successor, Gregory IX., a headstrong old man of eighty, was chosen almost as it would seem on purpose to lead the final attack from the side of the church. He was unrivalled in learning, in eloquence, and it may be added in ambition. Frederick on the other hand was the hero of adventure, the knight of knights, the adored prince, the bountiful patron of arts and learning, himself of fame as a poet and musician (troubadour), the liberal protector of all that was noble, regardless of narrow distinctions of creed or race. He was called Frederick the Magnificent from the splendour of his court, held now in his hereditary Sicily, now in the ancient feudal cities of the empire. His codes of laws are far beyond anything else of his age in breadth and justice. His son was already acknowledged his successor (King of the Romans). With such a position at the head of Europe how could he acknowledge the papal superiority? The very qualities we so admire were those which, in those days of narrow bigotry and wilful ignorance of all but church-learning, ruined this splendid prince in the eyes of ecclesiastics. Gregory at once summoned Frederick to depart on the crusade as he had definitely promised two years before, admonishing him also as to the luxury of his court, and especially as to his intercourse with Mohammedans, who formed one of the most industrious and cultured classes of Sicily. Frederick was known to speak Arabic, and this also was imputed to him as a crime. The emperor sent an embassy to the Sultan Malekal Kameel of Egypt, the result of which was that on condition of an alliance against the Sultan of Damascus, Kameel would deliver up the Holy City of Jerusalem. Frederick set sail from Otranto in September, 1227, but returned through illness three days afterwards, and the great armament, collected from various parts of Europe, dispersed. Gregory excommunicated Frederick, imploring the eternal malediction of God against him, while the clergy dashed down their torches and left the church in darkness for a symbol. Frederick simply replied that the Landgrave of Thuringia had actually died of the sickness, a clear proof of its severity. The pope denounced him as a liar, and twice repeated the excommunication. At last the Frangipani, a powerful noble house in Rome, driven beyond endurance by such perversity, expelled the pope from Rome. Frederick meanwhile had recovered, and in April, 1228, set sail for the second time for the Holy Land at the head of a small army of chosen knights. The pope despatched two friars to warn all the Christians in the East against Frederick as excommunicate. In spite of the vehement hostility of the papal party, extending even to plots against his life, and the opposition of the Templars and Hospitallers, Frederick procured a conference with Sultan Kameel, and amidst courtesies given and received, the emperor and the sultan signed a treaty on very favourable terms to the first, giving to the Christians Jerusalem (except the actual Mosque of Omar, on the site of the temple), Tyre, Sidon, and other chief towns in Palestine. At Jerusalem he crowned himself King of Jerusalem on the 18th of May, since no priest would crown him, for all Palestine was put under interdict by the pope. Yet the emperor's long discourse on this occasion is full of magnanimous forgiveness of the pope on account of the necessities of his office. But as news reached him that the papal armies were actually invading his dominions Frederick hastened back to Lower Italy, and, after fruitless negotiations with Gregory, reconquered his kingdom, and at length obliged the pope, in 1230, to free him from the excommunication.

Although interrupted by a short contest in 1237 with Frederick, duke of Austria, and by the rebellion of his son Henry, the emperor steadily pursued his Italian schemes. He was now supported by the Ghibelline party, and by Ezzelino, sovereign of Verona. His second son, Conrad, was elected King of the Romans in the room of the disgraced Henry, and in November, 1237, at the battle of Corte Nuova, he utterly broke the Lombard power, and received the submission of all the cities, Milan, Bologna, Piacenza, and Brescia excepted.

The pope was in the greatest alarm. With an emperor ruling from the Alps to Sicily the pope would be a mere vassal. Therefore Frederick was again excommunicated by Gregory in 1239; and Robert, brother of St. Louis of France, was invited to become emperor, with the full support of the papacy. Both the good Louis and his brother indignantly refused the offer and acquainted Frederick with the affair. Frederick, exasperated, declared war upon the pope, and prosecuted it with great vigour and success. Gregory, now nearly 100 years old, died in 1241. He was succeeded by Celestine IV., and he, after a short rule, was

succeeded by Sinibald Fiesco (Innocent IV.), who, as cardinal, had been the emperor's friend, but now became, as pope, his most formidable enemy. A general council was summoned by the new pope at Lyons, whither he had fled to endeavour to rouse France and England against the emperor. Frederick appeared by his chancellor, Thaddeus of Suessa, in order to defend himself from heresy and other charges. Without waiting for the decision of the council the most dreadful anathema was pronounced against him by the pope; a crusade was proclaimed against him, and all his subjects were released from their oath of allegiance to him. It was sought to raise a new emperor in his place, Henry Raspe, the landgrave of Thuringen. Frederick maintained himself bravely against all his enemies while justifying his conduct to Europe at large. The Lombards were kept in check, and conspiracy at court defeated. But when Peter de Vinea, his chancellor and life-long friend, was induced to attempt to poison Frederick, the emperor began to falter. Parma rebelled, and was lost to him, and in attempting to reduce it by siege he lost a fine army, great treasures, and his friend Thaddeus. Enzio, Frederick's natural son, a little later was made prisoner by the Bolognese, and in spite of enormous bribes offered by the emperor, was thrown into prison. (He lingered there for twenty-three years.) Rousing himself from his profound grief Frederick set forth again, was victorious in Lombardy, and would probably have humbled Innocent at last, when he was taken ill at Fiorentino, and died in the arms of his natural son Manfred, on the 13th of December, 1250, in the fifty-sixth year of his age and the forty first of his reign. He was succeeded by his son Conrad.

No prince of the middle ages, Charlemagne excepted, made a more distinguished figure. Endowed with rare qualities of body and mind, he fought with wonderful energy against aristocracy in Germany, against democracy in Upper Italy, and against an arrogant hierarchy in Central Italy, while seeking to reconcile and to unite in his own southern hereditary dominions the hostile elements of six different nations. The legend said to refer to Frederick Barbarossa, that that emperor was still living in a cave in the Salzburg, and would at some future time return to bring a golden age to Germany, is thought by some historians to refer to this extraordinary man.

FREDERICK III., Emperor of Germany, son of Ernest, duke of Austria, was born at Innsbruck, 21st September, 1415. While yet a minor he went to the Holy Land. In 1440 he was elected Emperor of Germany, on the death of his cousin, Albert II. Though, in mental capacity, quite unworthy of his high office, Frederick III. played a great part in one important transaction. He had for secretary one of the most astute men who ever lived, Æneas Sylvius Piccolomini, who later on wore the tiara as Pius II. Felix V., the antipope, elected by the Council of Basel, had Æneas in his service; but the tide showed signs of turning, and the wily Italian, under the first pretext that offered, induced Felix to send him in 1442 to the emperor's service, that, as he suggested, he might gain the imperial support against the church-pope, Eugenius IV., whom Felix and the Council of Basel had so long and so bitterly opposed. No sooner firmly in favour at Vienna, however, than Æneas dexterously reconciled himself with the offended pope, and went on a special embassy to Rome to bring about a union between the empire and the church (1446). This closed the last great schism the church ever endured. Felix quickly sank into a retreat, and the Council of Basel broke up. Successful in so great a matter, Æneas was next employed by the emperor to negotiate his election to the duchy of Milan, but the troops of Francis Sforza, husband of the late Duke Visconti's natural daughter, were more powerful than the arguments of Æneas. In 1452 Frederick entered Italy for his coronation at the hands of the successor of Eugenius, the good and learned Nicolas V., purest and best of all the mediæval popes. He was the last emperor crowned at Rome by the pope. (Charles V. was crowned by a pope, but at Bologna; Napoleon also, but at Paris.) On the death of his ward Ladislaus, Hungary preferred George Podiebrad and Bohemia Matthias Corvinus, though Frederick had expected both countries to have chosen him as king. In 1462 his brother Albert besieged him in Vienna, and it was his enemy Podiebrad who relieved him. The whole of the Austrian duchy fell to him at the death of Albert in 1463. In 1468 he went to Rome to talk about opposing the Turks, who, however, twice penetrated into his dominions. (Constantinople had fallen in 1453.) His wavering policy brought the Kings of Hungary and Bohemia upon him. In 1485 the King of Hungary took Vienna and all Lower Austria from him, which he did not recover till the king's death in 1490. At length his own death, on the 19th of August, 1493, relieved him from a position for which he was utterly unfitted. In 1477 his son Maximilian married Mary of Burgundy, the heiress of Charles the Bold.

FREDERICK-WILLIAM, Elector of Brandenburg, surnamed the *Great Elector*, was the son of the Elector George-William. Educated in retirement during the Thirty Years' War, the cruelty that prevailed, and the dangers that beset his family, greatly impressed him. In 1640, when his father died, he found his dominions in a terrible state, chiefly through the exactions of Wallenstein. He began at once to correct abuses, and to restore order to the finances. In 1642 he received the investiture of Prussia from the King of Poland. In 1643 he made peace with the Swedes, who were to evacuate the greater part of his dominions. At the peace of Münster, he failed in his claims on Silesia, but obtained Magdeburg, Wallenstadt, Minden, and part of Pomerania. Through him the two great divisions of the Protestant church obtained equal rights in that famous treaty. Frederick formed an alliance with Holland, but was compelled in 1655 to join the Swedes, with whom, in the invasion of Poland, he greatly contributed to the victory of Warsaw. Russia and Austria declared in favour of Poland, and a convention was made by which Frederick obtained the entire sovereignty of Prussia. In 1678 he completed the conquest of Pomerania. There was now peace, and he made excellent use of it in fostering the works of peace. In 1672 he aided Holland against France, by advancing into Westphalia; but he was badly served by his general, and had to make peace with the French, who were to quit Westphalia and pay him 800,000 livres, while he was to withdraw from the alliance with Holland. In 1674 he was again at war with France in support of the emperor. He invaded Alsace, defeated the Swedes at Fehrbellin in 1675, took Stettin, and in January, 1679, crossed the Frische Haff and the Gulf of Courland with his army on sledges over the ice, surprised the Swedes in their winter-quarters, and compelled them to quit Prussia. The French king, however, compelled him to restore all his conquests to Sweden, and to make peace, by the treaty of St. Germain. Besides his other services in the Protestant cause, he received no less than 20,000 French Protestants after the repeal of the Edict of Nantes, and was equally hospitable to the Waldenses. When the Prince of Orange was preparing for his descent on England he furnished several regiments, whose chief, Marshal Schomberg, was killed at the battle of the Boyne. Frederick died in April, 1688. His first wife was Louisa Henrietta, princess of Orange; his second, Dorothea, dowager-duchess of Brunswick Luneburg.

FREDERICK I. OF PRUSSIA (but, as Elector of Brandenburg, Frederick III.) was the son of Frederick-William, the Great Elector of Brandenburg. He was born in 1657 at Königsberg. Frederick succeeded to his father's electoral dominions in 1688. His first wife was the Princess of Hesse-Cassel; his second, Sophia Charlotte, sister

of George I., king of England. Immediately after his accession he assisted the Prince of Orange (afterwards William III.) with 6000 men for the expedition to England. In 1689 he aided the Emperor Leopold in laying waste the Palatinate, during the war with France, and two years later joined the Great Alliance against the same country. He also assisted the emperor against the Turks. In 1703 he took possession of the town of Elbing, previously mortgaged to his father, the Great Elector. By the war of the Spanish Succession he obtained the great object of his ambition, his recognition in 1701 as King of Prussia, the only part of his dominions over which he held absolute sovereignty. The emperor consented to recognize his title of king, on the condition that he would in all important matters aid the interest of the empire and of Austria. Frederick, as the ally of Austria, sent 20,000 men to the Rhine and 6000 to Italy, and his troops distinguished themselves against the French at Blenheim, Turin, &c. Before the close of the war he died, 25th February, 1713. He was slightly crooked from a fall in infancy.

FREDERICK-WILLIAM I., King of Prussia, son of Frederick I., was born in 1688, and educated at Hanover with the electoral prince of that country, afterwards George II. of England. He served in the allied army against the French, and distinguished himself at the siege of Menin and the battle of Malplaquet. In 1706 he married the Princess Sophia Dorothea of Hanover. Retrenchment, republican plainness and austerity, strict business habits, facility of intercourse with his subjects, were the characteristics of his reign, which commenced on the 25th February, 1713. He laid the foundation of the afterwards famous Prussian army. His passion for tall soldiers became a byword; he even kidnapped men from other states to gratify it. He encouraged the industrial arts, but hated the fine arts, sciences, poetry, &c. It may be said in his favour that he was liberal to extravagance in his public buildings, but only when they were strictly for the public, not for himself or court. In 1715 he declared war against Charles XII. of Sweden, who suddenly returned from Bender, and among other causes of quarrel demanded back Stettin. Rügen and Stralsund were taken, although Charles himself defended them. He was allowed to escape to Sweden by Frederick-William, though he had to force his way through ice in the sight of the Prussian army, and might readily have been shot. (He was assassinated three years later in Sweden.) In the Polish war of 1733 Frederick-William hospitably received Stanislaus, offending Russia and Austria. He assisted the latter, however, when war broke out again with France, until the peace of 1738. He died on the 31st of May, 1740, leaving his successor, Frederick the Great, 9,000,000 dollars in the treasury, an army of 70,000 men, a kingdom of 2190 German square miles, and 2,240,000 inhabitants, as the materials for the future greatness of the Prussian monarchy. This king, rough and savage from his youth up, is a mine of wealth to the unequalled pen of Carlyle. Probably no figure in history is so humorously and so accurately painted as this "great drill-sergeant of the Prussian nation," from his giving George II. of England (that was to be thereafter) a bloody nose in his boyhood to the thrice famous "tobacco parliaments" he held in his old age, discussing affairs of state with his old servants over a pipe. The handsome establishment of the vain old crooked king his father, first King of Prussia, he entirely dismissed, "from the highest goldstick down to the lowest page in waiting," within half an hour after his father's death, grimly records the historian. Darker passages occur, too: the attempted flight and consequent imprisonment of his son Fritz, and the execution of Fritz's friend upon small cause. Personal chastisement awaits Fritz and his witty sister Wilhelmina, whose memoirs are a store of anecdote. It is a question whether the first volumes of Carlyle's "Frederick the Great," which have this extraordinary man for their hero, are not even more generally admired than those which treat of Fritz himself. Passionate, unjust, ill-mannered, and tyrannical ("volcanic," in fact, as Carlyle calls him), Frederick-William was as honest a man as ever lived, and at heart a sincere lover both of the country and of the family he treated so harshly. It took him many years to see that his great son was of a different mould from himself; but that once accomplished he loyally acknowledged it, and a mutual respect grew up between the strangely assorted pair. It is a moot point whether the stern training of his youth under this Spartan father raised Frederick to greatness of mind, or prevented him from being greater than he was.

FREDERICK II., or THE GREAT, King of Prussia, son of Frederick-William I. and of Sophia Dorothea, princess of Hanover, was born on the 24th of January, 1712. His full name was Karl Friedrich (probably after the Emperor Charles VI.), but the Karl was soon dropped. Frederick himself used as a youth the French spelling always, *Frédéric*; and, as he grew older, *Féderic*, a curious version. His father's chief object in his education was practical knowledge, and especially the development of military prowess; but his own tastes lay towards music, poetry, and polite literature. Estrangement then arose between father and son; the former used excessive harshness and meditated leaving the throne to his youngest son, while Frederick determined to fly to England to George II., his maternal uncle. In corresponding with Katte, one of his friends, a misdirected letter let out the secret. Katte and the prince were seized, and both would have been put to death but for the intercession of the Emperor of Austria. As it was poor Katte alone suffered death, and Frederick was let off after imprisonment. He was not allowed to return to court until the marriage of his sister Wilhelmina, who had been in his counsel. Before this imprisonment, which lasted a year and a quarter, Frederick was a gay thoughtless youth, liking nothing so well as Frenchifying himself to the utmost in every conceivable manner; and throughout life French was as familiar as, or perhaps more familiar than, his native barbarous Prussian-German. Certainly he spoke and wrote better French than German. But when he appeared at his sister's wedding in November, 1731, she records in those witty memoirs ("Mem. de la Margrave de Bareith"), which are the best records of her great brother's youth, that he had quite changed, having become reserved, cold, and thoughtful.

In 1733 his father obliged him to marry the daughter of the Duke of Brunswick-Bevern, and in 1734 gave him the mansion and town of Reinsberg, near Ruppin, where he appears to have lived happily, chiefly devoting himself to literary pursuits and to music, especially playing on the flute, wherein he gained some considerable skill, till his accession. He had an uninterrupted correspondence with foreign writers, especially with Voltaire, whom he admired above all others, but with whom in after years, when as king he had invited him to Prussia, he had a bitter quarrel. He here composed several works, one of which was the "Anti-Macchiavel," published at the Hague in 1740. This was a fairly meritorious performance in answer to the famous "Prince" of Niccolo Macchiavelli. Its appearance anonymously, though with a significant hint from Voltaire, who corrected it and saw it through the press, took the world by storm. The open secret of the authorship was soon penetrated, and as by the time of its appearance Frederick was king, all Europe was on tiptoe with expectation. A king of such liberal opinions, and of such ability to express them, was in the worthless eighteenth century quite phenomenal. With all this, as his admirer Carlyle is constrained to admit, Frederick after his youth was "never fairly loved at all," and it may be added was not lovable either. The long religious discourses

his stern old father had made him submit to disgusted him for ever on that subject; he was cynical almost to infidelity, and possibly as another result of harshness his reserve was impenetrable. He never seems to have cared to have a confidant or a friend. His wife was a stranger to him. But it is wrong to call him heartless or dissembling. He was neither.

The death of his father in 1740 placed Frederick on the throne; and the death of the Emperor Charles VI., on the 20th of October, 1740, led the way to the extraordinary and brilliant career which changed the face of Europe. The three great wars in which Frederick was engaged had for their main object the possession and permanent annexation of Silesia to Prussia. He began by asserting his claims to four principalities of that country, but he only required, on terms, from Maria Theresa the duchies of Glogau and Sagan. These duchies, in virtue of a treaty of 1537 between their duke and the elector of Brandenburg of *Erb-verbruderung* (whereby in failure of line the surviving line either of Brandenburg or of Silesia was to inherit both states), should have fallen to Prussia on the failure of the Liegnitz line. But the Emperor Ferdinand I. at the time had forbidden this treaty; and Austria at the proper time seized these duchies and other lands thereabouts to which Prussia also laid claim. Nevertheless Prussia never abandoned these claims; nay, the father of Frederick the Great was prompted by England to assert them by war during negotiations for a marriage of Frederick to an English princess, and would have done so if the English government had, as they promised, sent English troops to assist him. Too weak, however, by himself, he left the task to his successor. Frederick the Great pretended to no high motives in this invasion of Silesia; he saw a fair chance of making good claims which, though two centuries old, he and his forefathers always had held good. Neither did he carry out his will in the most open or honourable manner. But it must be remembered that the Silesians received his rule gladly, and evidently regarded their incorporation with Prussia as a good to them. Further, the charge against Frederick that he broke the promise to uphold the PRAGMATIC SANCTION, given by his father to the Emperor Charles VI., falls to the ground when it is remembered that Frederick-William gave the promise and assented to Maria Theresa's succession on the condition that his inheritance to the duchies of Berg and Jülich should be secured (treaty of Wüsterhausen, 1726). But Austria had favoured the succession of the Elector Palatine, whereby evidently the treaty fell to the ground.

The queen refused Frederick's terms; he then seized Lower Silesia in December, 1740, defeated her army at Mollwitz, 10th April, 1741, and was joined by France and Bavaria in the War of the Austrian Succession, which sought to prevent Maria Theresa from succeeding her father, as provided by the Pragmatic Sanction, and to support the election of Charles Albert of Bavaria to Austria and the empire as Charles VII. at the beginning of 1742. Frederick carried off the brilliant victory of Chotusitz or Czaslau, 17th May, 1742. Peace was then concluded at Berlin on the 28th of July, and Upper and Lower Silesia, and a part of the county of Glatz, became Frederick's. The second Silesian War originated in Frederick's fears that the victorious Austrian arms would be turned against him in Silesia. He therefore secretly entered into an alliance with France, in April, 1744, and with the Emperor Charles VII., the Elector Palatine, and the Elector of Hesse-Cassel, on the 22nd of May, 1744. Frederick thus joined the supporters of the emperor, whom his rival the Queen of Hungary was pressing hard, for his own interest; but also greatly to the emperor's advantage. He undertook, namely, to conquer Bohemia for Charles, and in return was to have Silesia and some small neighbouring pieces of territory guaranteed to himself by his great allies. Accordingly, on the 10th of August, 1744, he unexpectedly entered Bohemia and took Prague, but was obliged to leave it before the end of the year, as he was totally unsupported by the French. The alliance was dissolved by the death of the emperor on the 18th of January, 1745, and the defeat of the Bavarians at Pfaffenhofen. On the other hand, Saxony and Austria combined against Prussia on the 18th of May, 1745; but Frederick defeated them on the 4th of June, at Striegau or Hohenfriedburg in Silesia, then entered Bohemia, and again defeated them at Sohr, on the 30th of September, 1745, and at Kesselsdorf on the 15th of December. Frederick entered Dresden, and peace (the treaty of Dresden) was then concluded, 25th December, 1745, leaving matters pretty nearly on the footing of the treaty of Breslau as regards Frederick. By this time the husband of Maria Theresa (Francis I.) had been elected emperor (13th September, 1745); and about the same time George II. of England, who had hitherto been upon the Austrian side, had made a separate peace with Frederick (16th August, 1745). Frederick had therefore no inducement to continue the war, once his conquests were duly secured to him.

During the eleven years' peace that followed, Frederick devoted himself with unremitting activity to the internal administration of his dominions, the organization of the army, and to literary pursuits. With his chancellor, Cocceji, he compiled the "Codex Fredericianus." Frederick also wrote "Memoirs of the House of Brandenburg," a concise, well written account of his house. Another work, a didactic poem in six books, on the "Art of War," is greatly esteemed. These and all his other works are in French. This is the period of Voltaire's attempted residence at Frederick's court as literary autocrat, and his final stay there of thirty-two months, ending in the disastrous quarrel of July, 1753, not altogether creditable to either side, but out of which Frederick comes far better than his illustrious friend. Voltaire, by retaining some satirical pieces of Frederick's liable to cause mischief in allied courts, brought upon his head such disgrace as he received; but he was so stung by it that he resorted to the most mendacious calumnies, and displayed all the vanity and personal meanness which so continually defile his true greatness of mind. Frederick's behaviour was dignified in the whole affair. One of his grand objects was to improve his revenues, in order to maintain his army, which he had increased to 160,000 men, then considered an enormous strength.

When the war broke out between England and France in 1775, the former concluded a treaty with Frederick, the chief object of which was to secure Hanover from invasion. This led to a secret alliance between France, Austria, Saxony, and Russia, of which Frederick having been privately informed, chiefly through the treachery of a clerk in the Saxon chancery, became once more apprehensive concerning Silesia. He accordingly resolved to anticipate his enemies, and commenced operations by invading Saxony on 24th August, 1756, which was the beginning of the third Silesian War, or as it is generally called, the Seven Years' War. This contest was the most extraordinary and important in modern times, prior to the wars of the French Revolution. Though Frederick is the hero, the history of the war is, in fact, the history of continental Europe. Its leading events in 1756 were, as regards Frederick, the defeat of the Austrians at Lobositz (1st October), and the surrender of the Poles in the same month at Pirna. The great victory of 6th May at Prague, followed by as great a defeat by the Austrians (18th June) at the same place, render memorable the campaign of 1757; then came the invasion of Prussia by the Russians and Swedes, who retreated after Frederick had completely overthrown at Rossbach the French and Austrians on 5th November; and lastly, the defeat of the

Austrians at Leuthen or Lissa (5th December), and recovery of Breslau from them. An annual grant of £670,000 from England marked the opinion of its government in his favour. The chief events of 1758–60 were the failure of Frederick in the siege of Olmutz, and his defeat of the Russians at Zorndorf, 20th August, 1758, at a frightful sacrifice of life; their success at Kunersdorf, 12th August, 1759, followed by other reverses from the Austrians; the fruitless bombardment of Dresden in July, 1760, by Frederick; the sudden occupation of Berlin itself for a week by the Russians in October: and the final defeat of the Austrians at Torgau, 3rd November, 1760, when Frederick's affairs had seemed almost desperate. In 1761 Marshal London surprised Schweidnitz, and the Russians took Colberg. In 1762 everything was changed by the death of the Russian empress, Elizabeth, on the 5th of January, and the accession of Peter III., an enthusiastic admirer of Frederick, with whom he immediately concluded a treaty of alliance. Peace was also made with the Swedes, and though Peter III. was soon deposed yet Catharine, who succeeded him, observed a strict neutrality during the remainder of the war. Frederick recovered Schweidnitz by siege in October. At last peace was concluded between Great Britain and France, and Austria and Saxony were obliged to conclude a peace with Prussia (February, 1763). Thus ended the Seven Years' War, which, after immense sacrifices of human life and treasure, left the political balance of Europe unchanged. Frederick reckoned that 853,000 men fell in battle, and many times this number perished of want and misery. The population of Prussia (which lost 180,000 soldiers) was reduced by 500,000 inhabitants.

Frederick now seriously directed his attention to repair the evils inflicted on his dominions by the war. Meantime he continued to maintain a very large army. In 1772 he agreed to the first partition of Poland, by which he obtained all Polish Prussia and a part of Great Poland. From that time the kingdom of Prussia was divided into East and West Prussia. In 1778, on the death of the Elector of Bavaria without children, he interfered to prevent Austria from partitioning that country. By the treaty of Teschen, in May, 1779, Austria consented to the union of the Franconian principalities with Prussia. In 1785, to prevent the emperor from obtaining Bavaria in exchange for the Low Countries, the Elector of Bavaria to become a king of Burgundy, &c., Frederick formed the alliance between the German princes, called the "Fürstenbund," which has been considered as the masterpiece of his policy. In 1786 he concluded a treaty of amity and commerce with the United States of America. He died on the 17th of August, 1786, at his favourite palace of Sans Souci, in the seventy-fifth year of his age and the forty-seventh of his reign. He had no children. He left to his nephew, Frederick-William II., a kingdom enlarged from 2190 to 3515 German square miles, and an army of 200,000 men unrivalled in Europe.

His posthumous works, in fifteen volumes, contain the history of his own times, the history of the Seven Years' War, and Memoirs. They are, however, by no means the most valuable documents in the career of this extraordinary man. For his younger days the Memoirs of his sister Wilhelmina, margravine of Baireuth (or as she spells it, *Bareith*), are invaluable. Voltaire's correspondence with him is also very interesting for the most part. In 1884 an exceedingly valuable work was published by the State Archives at Berlin, the Diary, &c., of a M. de Catt, reader and private secretary to Frederick from 1756 onward for several years, and admitted nearer the king's own heart than almost any other person. In an astonishing passage, of undoubted veracity, he shows us Frederick writing verses, and correcting Rousseau and Racine as an exercise to refresh his thoughts, on the eve of the crucial struggle of Zorndorf, with 32,000 Prussians to oppose at least 50,000 Russians; interrupting his pastime occasionally for half an hour as his generals arrive to dictate the plan of the morrow's battle. During the whole campaign he read Cicero with De Catt morning and evening, though the speed of the marching was excessive. In 1883 the partisan book of the Duc de Broglie appeared ("Frederick the Great and Maria Theresa," trans. Cashel Hoey, London) —a worthless diatribe against Frederick, but of merit where on side topics the writer's really valuable knowledge has fairer play; and in the same year an equally partisan account of Frederick in his English dealings, but this time a panegyric upon the king, by a Berlin professor who treats him as a demigod, was issued from the pen of Professor E. du Bois-Reymond ("Friedrich II. in Englischen Urtheilen," Berlin, 1883). Yet great as is Herr du Bois-Reymond's hero, the lover of autocratic government can surely not forget that hardly was the great man gone, who upon such principles built up the most powerful war-machine in Europe, than Prussia lay in utter ruin on the field of Jena. Probably "Father Fred" (*Vater Fritz*) will be found greater as time goes by in his years of most silent state-work between the second Silesian War and the Seven Years' War, and in the masterly work of repairing the damages to the country which he carried through from the close of the Seven Years' War till the period of his death. One is tempted to compare with this the manner in which Goethe closes his masterpiece, with Faust all powerful, yet finding his greatest happiness in draining fens and such quietly beneficent work. It is with such pictures of the great king that Carlyle closes his immortal work ("Frederick the Great," London, 1st edition, 1858–65, frequently reprinted), at once the finest and fullest account of Frederick, and a masterpiece of historical biography. A capital brief account of Frederick, especially from the military side, was put forth by Colonel Brackenbury in 1881 (London).

Frederick-William II., King of Prussia, was born in 1744. His father was Augustus-William, second son of Frederick William I., upon whose death, in 1758, he was declared Crown Prince of Prussia by Frederick the Great, whom in 1786 he accordingly succeeded.

In 1787 he sent an army to Holland, and reinstated the stadtholder, whose rights the patriots had refused to acknowledge, and had also personally offended his wife, Frederick's sister. A defensive alliance between Holland, Prussia, and England was concluded at the Hague in 1788. The same year he, with England, prevented Denmark from attacking Sweden during the war between Russia and Sweden. By an alliance with the Porte in 1790 he offended Austria; but the latter eventually restored most of its Turkish conquests, and Austria and Prussia entered into friendly relations, and invaded France in 1792. Through the manœuvres of Catharine II. of Russia, Frederick found himself compelled in 1793 to contend with Russia in favour of Poland or to divide the kingdom with Russia. He chose the latter, and took possession of Great Poland. In 1794 the Poles rose under Kosciusko and Madalinsky, and several times defeated the Russians and Prussians, until Kosciusko was taken prisoner and Praga was stormed by Suwaroff. What had been left of Poland by the previous partitions was now by the third partition divided between Austria, Russia, and Prussia. (The first partition was under Frederick the Great, in 1772.) He made peace with the French Republic on the 5th of April, 1795, leaving to it all the Prussian territories beyond the Rhine. During this reign the Margrave of Anspach and Baireuth ceded those principalities, on purchase, to Prussia. Frederick-William died on the 16th of November, 1797. A new code of laws was introduced by him. The toleration he desired to maintain was much restricted by those about him, and especially by the religious edict of 1788.

FREDERICK-WILLIAM III., King of Prussia, was the eldest son of King Frederick-William II., by his second wife, Frederike Louise, princess of Hesse-Darmstadt: he was born on the 3rd of August, 1770. He was educated under the eye of Frederick the Great, who was very fond of him. He succeeded to the throne on the 16th of November, 1797, having already distinguished himself against the French. In 1794 he had contracted a happy marriage with the Princess of Mecklenburg-Strelitz. The monarchy was now three times as extensive as when Frederick the Great came to the throne, but was weak in Poland, and was in debt. He first, therefore, reorganized the internal administration, struggling the while to preserve neutrality in the mighty European contest then raging. With the aid of France, however, he did not hesitate to increase his dominions, at the peace of Luneville, by the incorporation of Hildesheim and other bishoprics, &c., in return for Prussian territories previously ceded to France on the left bank of the Rhine. General mistrust against him prevailed among the European powers on account of his French alliance, and he was nearly drawn into a war with England, on the occasion of the seizure of one of his ships; but before he had too far committed himself Copenhagen was bombarded, and the Russian emperor, Paul, assassinated—events that led to material changes in the relations of the chief powers. At the request of Bonaparte, Frederick dismissed Louis XVIII. and the French emigrants from his dominions; and when Napoleon crowned himself emperor in 1804 the Prussian king was the first to acknowledge him and to wear the grand cross of the new legion of honour. All this increased against him the hostility of the legitimists of Europe. In 1805, when Napoleon's designs against England were frustrated by the new coalition of Russia and Austria with Great Britain, the Prussian king seemed almost to hold victory in his hand for the side he might espouse. He still remained neutral; in front, however, of a large army. The French under Bernadotte first violated his territory; this led to an interview with the Emperor Alexander, and eventually to the passage of a Russian army through his kingdom. Napoleon concealed his wrath, won the battle of Austerlitz, and then received the congratulations of the Prussian minister: "Thank God you have conquered!" "If I had lost, he would have said the same to the emperors of Russia and Austria," observed Napoleon subsequently. The Prussian king was now again all French in his policy. He gave up Franconia to France, and received a compensation in Hanover in return, until peace should be made with Great Britain. Growing bolder, however, with time, he concluded in 1806 a second convention with France, in consequence of which he declared he had received Hanover as a lawful conquest of Napoleon. Of course this was followed by a declaration of war with Great Britain, which soon seized several hundred Prussian ships. The king could not at the same time fail to perceive the little real respect Napoleon had for him, when the latter formed the Rhenish Confederation without consulting so important a state as Prussia. Other provocations were given, and the spirit of the people was aroused. It was not, however, till he learned that secret negotiations were going on between France and Great Britain at which it was agreed Hanover should be given up, that he listened to the persuasions and offers of Russia, and demanded from Napoleon the evacuation of Germany by the French armies. Napoleon refused, and war began. Prussia was supported by Saxony, Hesse-Cassel, Brunswick, &c., as well as by Russia.

The war broke out on the 1st of October, 1806: a fortnight afterwards the glory of the Prussian name was prostrated on the field of Jena. Another fortnight, and Napoleon entered Berlin. On the 14th of June, the fate of Prussia was decided on the field of Friedland, when nearly the whole kingdom fell in a few days into the hands of the French. Frederick-William and Alexander now sued for peace, which was settled at the memorable meetings of the three sovereigns on the raft at Tilsit. By the new treaty of 7th July Frederick lost all the territories west of the Elbe, and nearly the whole of his Polish dominions—in fact, the greater part of his kingdom. Frederick was also to reduce his army to 40,000 men, and was to pay nearly £6,000,000 sterling to France. The king, on his return to Berlin, in 1809, when the French evacuated it, made many internal reforms of a popular kind. He abolished the last remnant of peasant bondage, declared merit, talent, and learning the sole qualifications for the public service, and rendered the municipal corporations open and in a measure self-governing. The military system was radically altered. Every able man was bound to fight in case of necessity, and to serve in the army for three years. The finances were gradually recruited by the most extreme economy, in which the king set a worthy example to all.

In 1812 the king had to appear at Dresden among the potentates who attended the emperor, and to send 20,000 men with him onwards to Russia. These fought well until the retreat, when suddenly their commander, York, made a truce with the pursuing Russians, and they were allowed to retreat into Prussia. York's conduct was disavowed, but Napoleon knew what it meant. On the 28th of February, 1813, the king signed a treaty of alliance with Russia, and on the 17th of March following roused the whole country, as one man, by his famous proclamation against the French. The Prussians and Russians were beaten at Lützen on the 2nd of May, and at Bautzen on the 20th or 21st of May. Negotiations now took place ineffectually. The war recommenced. Sweden and Austria were now with the allies, Denmark had joined France. The allies had, it is said, 500,000 men, including above 200,000 Prussians; Napoleon much less. Having gained another victory at Dresden, the French were afterwards beaten in a series of battles. The Prussian general, Blucher, was now in the ascendant. At last, on the 16th, 18th, and 19th of October, 1813, the French power was broken before Leipzig. France was now invaded, and numerous battles were fought, and at length the allied armies stormed the fortifications of Paris, gained the battle of Montmartre, and on the day following, the 31st of March, 1814, entered Paris. On the 2nd of April Napoleon was deposed by the senate.

Frederick-William, Alexander, and Blucher visited London at this time. After a triumphal entry into Berlin the king proceeded to the congress of Vienna. Here he received back the grand-duchy of Poland, nearly all his former German possessions, and other territories, as well as the larger half of Saxony, whose king was then a prisoner. He also obtained Swedish Pomerania in exchange for Lauenburg. When Napoleon returned from Elba in 1815, he aimed his first blow at Blucher, and won the battle of Ligny; Blucher, however, retreated in good order to Wavre, and was able to appear at Waterloo in time to follow up and secure the victory. Frederick-William signed, with the other powers, the second treaty of Paris. He eagerly joined the Holy Alliance proposed by Alexander, and then, having gained all by the people, he broke the important promises he had made them of a representative constitution. Frederick-William died on the 7th of June, 1840.

FREDERICK-WILLIAM IV., King of Prussia, eldest son of Frederick-William III., was born at Berlin, 15th October, 1795. At the age of eighteen he was reputed one of the most accomplished youths in Germany. He was with the Prussian army during the wars of 1813–14, but on account of his youth held no command. On his return he was nominated governor-general of Pomerania, in which office he gained the love and esteem of the whole population. When, at the death of his father, 7th June, 1840, he ascended the throne, he commenced his reign by promising a most liberal government. In less

than three years after his accession, however, all was completely changed. The liberal advisers by whom Frederick-William was surrounded fell into disgrace, one after the other; and their places were filled by men known for their reactionary sentiments, such as Professor Stahl, Hessenpflug, and others. These retrograde tendencies were in full force when the revolution of March, 1848, gave them a momentary check. The populace of Berlin having conquered the royal guards in a most sanguinary street fight, the king was compelled to come down from his palace, and, with bare head beside the corpses of the fallen insurgents, had to swear that he would grant a liberal constitution. For a short time it seemed as if Frederick-William was really inclined to keep his word; but no sooner had the popular excitement subsided than he revoked his concession, and modified the constitution of 1848 to such an extent as to make it the mere shadow of a popular representation. In 1857 the king was seized with remittent attacks of insanity, and Prince William of Prussia, brother of the king and next heir, undertook the government of the country, under the title of regent, till his own accession in 1861. Frederick-William was married 29th November, 1823, to Princess Elizabeth of Bavaria, born 13th November, 1801, daughter of King Maximilian Joseph of Bavaria. There was no issue of this marriage. The king died 2nd January, 1861.

FRED'ERICKSBURG, a town of Virginia, on the Rapahannock River, and on the railway from New York to New Orleans, 70 miles S.S.W. of Washington. Population, 5010. It has a court-house, gaol, several churches, and a market-house. The falls of the Rapahannock, in the vicinity, afford good motive power, and the town is supplied with excellent water, conveyed by pipes from the river. Near it Washington was born, 1732, and here a battle took place between the Federal and Confederate forces on the 13th December, 1862, in which the former were repulsed with great slaughter.

FREDERICKTON, the capital town of New Brunswick in Canada, is situated on the St. John River, 88 miles from its mouth, and 56 miles N.W. of the seaport of St. John. The river is navigable up to the town for large steamers, and there is a considerable trade in lumber. The town also forms the chief entrepôt for the trade of the interior of the province. Fredericton is well built. Its chief edifices are the provincial hall, the government house, the county court-house, the cathedral church, and the university. The population is 8000.

FRED'ERIKSHALD or **FRED'ERIKSHALL,** a town in the stift of Christiania, situated on the east coast of Norway, at the mouth of the Tistedelf, in the Ide-fiord, 58 miles S.S.E. of Christiania. It is well built and has a good harbour, with an active trade in tobacco, iron, sugar, and wood. Frederikshald is an open town, but immediately above it, on a perpendicular rock, 400 feet in height, overhanging the se. , is the strong fortress of Frederiksteen, at the siege of which Charles XII., king of Sweden, was killed, on the 30th of November, 1718. It was doubted for a while whether the king met his death by a ball from the fortress or had been assassinated, but there seems to be no good grounds for supposing that treachery had anything to do with the matter. An obelisk has been erected on the place where the king fell. Population, 9000. Until 1665 the town was called Halden, "the hold," when Frederick III. changed the name to Frederikshald, owing to the bravery with which the inhabitants repelled the attacks of the Swedes in 1658, 1659, and 1660.

FREE CHRISTIAN. The term Free Christian has often been understood as synonymous with Unitarian, and the title has frequently been adopted by Unitarian congregations, either, as their critics assert, because they have not the courage of their convictions, or, as they themselves would probably maintain, because the name Unitarian covers too small a portion of their religious tenets to be fairly descriptive of their position. Whatever may be the merits of the case as between those religionists who discard and those who desire to retain an appellation inherited by them from the times of Priestley and Belsham, the question assumes an altogether different aspect, and its essential bearings are materially altered, when a new congregation is formed on an undogmatic basis by the gathering in of malcontents from various denominations. The Free Christian acknowledges by the latter part of his name his historical indebtedness not only to the person of Christ, but to the theology, the philosophy, the culture, the science, and the art of the past eighteen hundred years, all of which have come down to him as a member of the European family through Christian sources and in a Christian form. By the epithet "Free" he so qualifies that Christianity as to let it be understood that he regards himself as in no sense bound by it to any of the preconceptions, dogmas, or definitions of ecclesiastical tradition, that he is free to accept alike the discoveries and the speculations of modern times, and to apply to the Bible and to current religious opinions the same critical tests that he would apply to any other religious system.

FREE CHURCH OF SCOTLAND. This church was formed in 1843, and owes its origin to the violation by the law courts of the hereditary rights and privileges of the Established Church of Scotland. It was a fundamental principle of that church that no minister should be intruded into any pastoral charge contrary to the will of the congregation, though during the latter part of last century the rights of patrons were enforced by the church courts in the most arbitrary manner, and presentees who were most obnoxious to the people were settled, sometimes under the protection of the military. But after the revival of evangelical principles in the church, mainly through the influence of Dr. Chalmers, strenuous efforts were made to put restrictions on the law of patronage, and to vindicate the rights of the people in the choice of their pastors. At length in 1834 the General Assembly passed the Veto law, by which it was declared that if a majority of the male heads of families in a vacant parish expressed their disapproval of the person nominated by the patron, he should be set aside, and the charge be conferred upon another preacher.

The Veto law was working smoothly and giving general satisfaction when Lord Kinnoul presented a Mr. Robert Young to the parish and church of Auchterarder in Perthshire. The presentee was so unacceptable to the people that only two of the parishioners signed his call, though there were 3000 souls in the parish, and 287 heads of families out of 330 recorded their dissent against his settlement. He was, in consequence, set aside by the church courts, but he and the patron resolved to carry their case before the Court of Session, and by a majority of eight to five the judges decided that it was *ultra vires* of the General Assembly to pass the Veto law, and that the presbytery of Auchterarder had acted illegally in rejecting Mr. Young on the ground that he was unacceptable to the people. This judgment was confirmed on an appeal to the House of Lords. A second action was instituted by Lord Kinnoul and Mr. Young to have it declared that the presbytery were bound to take the latter on trial, and if found qualified in respect of doctrine, literature, and character, to induct him into the living. This suit also was decided in favour of the pursuers by the majority of the judges. Other cases of a similar kind speedily followed. The Court of Session issued a decree requiring the presbytery of Strathbogie to take on trial and admit to the office of the holy ministry a Mr. Edwards, who had been vetoed by the people of Marnoch. It interdicted the preaching of the gospel and the administration of ordinances throughout the whole district of Strathbogie by any minister of the church under

authority of the church courts. It interdicted the General Assembly and inferior church judicatures from inflicting church censures, in one case upon a minister found guilty of theft; in a second, upon one accused of fraud; and in a third, upon a licentiate guilty of drunkenness, obscenity, and profane swearing. The Court of Session also reponed ministers who had been suspended from their offices, and interdicted the execution of a sentence of deposition from the office of the holy ministry pronounced by the General Assembly of the church; and in these and various other ways usurped ecclesiastical authority, and violated the spiritual rights and privileges of the church. An appeal made to the legislature for protection against these proceedings was rejected, and the church was left to choose between submission or separation from the state. In consequence 474 ministers and a large body of the people abandoned the Establishment and founded the Free Church, in order to maintain the doctrine of the headship of Christ and the rights of the Christian people.

The difficulties which the ministers who had sacrificed their all for conscience' sake had to encounter were very great. As they had adherents more or less numerous not only in every county, but in every parish in Scotland, necessity was laid upon them to set up and sustain the whole equipment of a church all over the length and breadth of the land. Provision had therefore to be made, not only for the support of the ministers who had resigned their stipends, manses, and glebes in connection with the Establishment, but also for the hundreds of probationers who were to be settled in newly formed congregations. Funds had to be raised for erecting churches, and schools, and theological colleges for the education of candidates for the ministry and for the training and support of teachers. As the whole of the foreign missionaries connected with the Establishment had cast in their lot with the "Free Protesting Church of Scotland," provision had to be made for carrying on missionary operations as heretofore among the heathen and in all the principal colonies. A fund was also required for the support of aged and infirm ministers, and for the cost of management and other necessary expenses. Not a few persons were of opinion that this vast work was quite beyond the strength of the infant church; but its adherents set themselves vigorously and zealously to its performance, and it very soon became evident that their financial undertakings were to be crowned with brilliant success. The backbone of the system was the plan of a common fund devised by Dr. Chalmers for the support of the ministers, of which they should each obtain an equal portion. As all the congregations of the church were to share in the benefits of this fund they were all required to contribute towards its support. An association was formed for this purpose in each congregation, and collectors were appointed to make monthly calls on the members for the purpose of receiving their contributions. This plan, with some modifications, has been steadily carried out to the present day with astonishing success. In 1843-44 the income of the Sustentation Fund, as it is called, amounted to £68,704 14*s.* 8*d.*; in 1853-54, to £94,635 10*s.* 6*d.*; in 1863-64, to £115,784; in 1883-84 it had risen to £171,156; and in 1884-85, to £171,358.

The ministers who seceded from the Establishment in 1843 amounted to 474; in 1869 the number had increased to 942—the dividend from the Sustentation Fund that year being £150. In 1885 the equal dividend from the fund amounted to £160, and was shared by 1116 ministers. In addition 774 ministers received some £17, others £8 10*s.* each from what is called the Surplus Fund. These sums are exclusive of the stipend paid by the congregations to their respective ministers. Most of them have also comfortable manses provided at a cost of upwards of £800,000. The church-building fund has been equally successful. Provision was rapidly made, not only for the spiritual instruction of the multitudes in all the cities and towns and in nearly all the rural parishes of the Lowlands, but also for the population of the Highlands and Islands, who had in a body connected themselves with the new and independent church. Owing to the refusal of sites by a number of the landowners in various parts of the country, and especially in the Highlands, considerable numbers of the adherents of the Free Church were compelled to worship in all states of the weather for some years on bare moors, in gravel pits, on the sea-shore within high-water mark, and even on the public road. But in the end the influence of public opinion compelled the site-refusing landlords to desist from these intolerant and oppressive proceedings, and to afford to their tenantry and retainers the means of providing for themselves comfortable places of worship. The number of churches which have now been erected, including double churches for several congregations in the Highlands, is about 1100; and as no fewer than 200 probationers quitted the Establishment in 1843, ministers were quickly provided for the greater part of the seceding congregations. Between 1843 and 1885 the sum of £2,891,867 was expended on buildings. The local building-fund in 1884-85 amounted to £96,399, while £5455 were raised for church extension building. The revenue of the aged and infirm ministers fund in that year was £7273. A theological college was at once erected in Edinburgh, and subsequently a second seminary of the same class was instituted in Glasgow, and a third in Aberdeen, at an aggregate expense of £55,000. The Glasgow college has an endowment from legacies, donations, and subscriptions of £35,000. The other two, though not endowed, possess an equal revenue. They are conducted by thirteen professors, and are attended by about 250 students.

It was confidently asserted that as the enthusiasm of its adherents cooled, the funds of the Free Church would fall off; but they have, on the contrary, steadily increased. The building fund in 1843-44 was £227,837, and this large sum, raised at the outset, made the average of the first five years of the existence of the church reach £318,086. The average of the second five amounted to £285,683; of the third five, to £305,029; of the fourth five, to £333,803; of the fifth five, to £369,618; of the sixth five, to £426,643; of the seventh five (to 1878), to £542,524; of the eighth five (in 1883), to £584,255. In 1881-82 the revenue of the Free Church amounted to £607,680; in 1882-83, to £580,059; in 1883-84, to £628,222, of which £88,551 were raised during that year for home and foreign missions; and in 1884-85, to £621,728 4*s.* 11*d.* This sum is exclusive of the receipts under the widows' and orphans' schemes, amounting to £29,000, which do not come into the hands of the treasurer of the church. The total amount of the freewill offerings of this religious body since 1843 is £17,097,308.

The membership of the Free Church of Scotland was in 1881 312,429; in 1886 it had increased to about 325,000.

FREE CITIES OF GERMANY, or *Free Imperial Cities*, are or were those cities which acknowledged fealty to the emperor direct, as if they were sovereign states. Of these some, such as Worms and Cologne, acquired power at a very early date, probably as early as the break-up of the Roman Empire. Most of them, however, did not take on their quasi-republican form till the twelfth century. At this time large numbers of them gained or asserted their independence. In 1241 the HANSEATIC LEAGUE was founded, which lasted for four centuries (dissolved 1630). The Rhenish League followed suit in 1246. Before the rise of Napoleon to power there were no less than fifty-one free imperial cities, forming a third *collegium* of the imperial diet, as settled by the peace of Westphalia in 1648. Of these fourteen formed the "Rhenish bench," among

which were the great towns of Cologne, Aix-la-Chapelle, Worms, Spires, Hamburg, Bremen, Lübeck, Frankfurt, Müllhausen, &c.; and thirty-seven formed the Swabian bench, Augsburg, Nuremberg, Ratisbon, and Ulm being the chief. Cologne, Aix, Worms, and Spires fell to France in 1803, and the rest were dispersed among the states of the empire, all except Hamburg, Bremen, Lübeck, Frankfurt, Augsburg, and Nürnberg, which retained their independence. The four great towns of Hamburg, Bremen, Lübeck, and Frankfurt were seized by Napoleon in 1810 for the sake of their commerce; but at the Congress of Vienna in 1815 they were rewarded for their struggles against the tyrant by a renewal of their independence. All the other numerous free cities had sunk to rise no more. In the war of 1866 Prussia annexed Frankfurt. The others still retain their independence.

FREE REED, the basis of tone for the concertina, the American organ, and the harmonium; while the beating reed is that used in the organ. The tongue of the free reed is smaller than its box, and plays freely through it; that of the beating reed is larger than its slit, and beats against its sides. See REED.

FREE SOCAGE was one of the feudal tenures, and entitled the holder to his land upon certain specified services, differing herein from *knight's service*, where the service was irregular and undefined, according to the quarrel on hand. The free-socager owed his lord so many days' work, as perhaps a week's ploughing or harvesting, with sometimes a yearly fine or rent in addition. By the dying out of other tenures, and the abolition of feudal homages, incidents, and reliefs at the restoration of Charles II. (1660), free socage became almost universal for a time. Borough tenure, or burgage tenure, was a free socage applied to houses in a borough, or sites for houses. Villein socage, instead of requiring free labour as free socage, required certain specified household or menial services. The latter became to a large extent copyholders in the course of time.

FREE SPIRIT, BRETHREN OF THE, an heretical sect of the mediaeval period which flourished during the thirteenth and fourteenth centuries in France, Germany, and Italy. They appeared first in Alsace somewhere about the year 1212, their leader being named Ortlieb, from which they are sometimes known as Ortliebians. The theology of this sect seems to have been of a pantheistic character, and its members declared themselves to be above all law, and from their union with God incapable of sin. They wandered about the country in Alsace in troops of both sexes, and openly practised the most shameless immorality. Coming under the ban of the church they were compelled to spread their doctrines secretly, but they succeeded in gaining a following in most of the nations of the Continent. They were subjected to the fiercest persecution by the Inquisition, and disappeared from history as a sect about the beginning of the fifteenth century, though some points of their doctrine and similar Antinomian practices have been found in connection with more than one sect of later date.

FREE STYLE of harmony, in music, is opposed to *strict style*. The latter admits only diatonic notes, subjects every note of the scale to the same laws, uses the Fourth to the bass as a discord, disallows unprepared discords except as passing notes, &c. The free style, on the other hand, uses chromatic notes freely, treats certain notes quite exceptionally (the tonic, the dominant, and the subdominant used as basses, and several notes forming parts of their respective chords), uses the Fourth to the bass in certain cases as a concord, freely makes use of fundamental discords unprepared, and considerably modifies the rules of the strict style as to passing notes.

FREE STYLE of counterpoint, in music, is a loose sort of composition, in which most of the sternest prohibitions are done away with. It thus becomes useless as an exercise, while retaining all that there is of the uninteresting in counterpoint as to artistic effect.

FREE PARTS, in music, are additional parts to a fugue or chorale, &c., somewhat in the nature of an *obbligato*: enriching and completing the effect, while not exactly forming part of the main body of the work.

FREE TRADE, a term which is used to denote such commercial intercourse between nations as is unimpeded by legislative enactments and protective duties. It exemplifies in foreign trade the principle of the division of employments, the advantages of which are accepted as an axiom of political economy. While, however, the principle that to obtain the best results men must be allowed to do such work as they are best fitted for, and to do it in the best possible way, is generally admitted so far as internal affairs are concerned, its application to commercial intercourse with foreigners is by no means generally accepted by civilized nations, and the majority at present adhere to the opposite principle of protection. In Great Britain free trade is of comparatively recent adoption, and during the early part of the present century the term was but the badge of a political party, which was baffled and defeated in its efforts for a long period, and was regarded with intense aversion by the influential classes of the nation.

Up to this period the efforts of the government had been continually directed towards the regulation of the commerce of the country with the view of obtaining an advantage over foreign countries, or at least of protecting native industry. To this end numerous laws were passed to encourage exportation and to hinder importation, the latter being the more important in their influence. Sometimes these principles were reversed to obtain the same ends, and the export of such articles as were considered necessary to the national welfare was prohibited, while free importation was encouraged; but in every law passed to regulate commerce the notion of protection was implicitly accepted.

By the labours of the political economists of the preceding century much light has been thrown upon the true laws of commercial intercourse, and in the essays of David Hume on "Commerce," "Money," "Balance of Trade," &c., published in 1752, and Adam Smith's "Wealth of Nations," which appeared in 1776, many principles were enunciated which are in accordance with the most advanced ideas of the present day. At the time when these works appeared the landed gentry and the farmers were in favour of freedom of trade, inasmuch as England was then enabled to export agricultural produce; while the manufacturers, struggling on with imperfect and defective machinery, were ardent protectionists. At the commencement of the present century these positions were reversed, inasmuch as the progress of mechanical discovery had given the manufacturers the superiority over their continental rivals, while the demands of an increased population for food had rendered the importation of corn necessary. Notwithstanding, however, the teachings of political economists and the struggles of contending interests, the British system remained strictly protective up to the year 1824, and nearly everything that could be obtained from abroad was subjected to the payment of a heavy import duty, while some foreign manufactures were prohibited entirely. In that year, however, the first breach was made in the wall of protection by the removal of the prohibition on the importation of silk manufactures, and a reduction of the duties on raw and thrown silk also. This slight relaxation, however, was not followed by any further change of importance for several years, and the battle was ultimately fought out on the question of the duty on corn, for an account of which see ANTI-CORN-LAW LEAGUE.

Formed in the month of September, 1838, this association laboured with tremendous energy for the cause of free trade; but it was not until the potato blight had brought

the people of Ireland into imminent danger of perishing by famine that victory was obtained. Important concessions to the principle of free trade had been made in 1842, 1844, and 1845, but the final blow to the protective policy was not given until 1846, when a bill was passed which provided for the speedy extinction of the duty on corn, and another which reduced to a minimum the duties on other articles of foreign produce. In 1849 the navigation laws were also repealed, and in a few years more the last remnants of protection were removed, and the country fully committed to the policy of free trade.

The period which has elapsed since this change was made has been sufficient to give the new policy the fullest trial, and the result has been such as to justify and even surpass the expectations of the boldest of its advocates. Notwithstanding the large increase in the population of England during this period, there can be no question that the standard of comfort among the labouring classes is much higher than it was during the days of protection. The foreign trade of the kingdom has enormously increased, and the commercial marine has been more than doubled in its tonnage. Protection as a policy has now very few advocates in England, and though a few attempts have been made to raise the old cries as a political manœuvre, they have hardly been taken up seriously by anybody.

In one respect, however, the anticipations of the free-traders have been doomed to disappointment, and that is with regard to the adoption of this policy by other nations. Not only do we find the great nations of Europe and the United States of America clinging steadfastly to the principles of protection, but they have also been adopted by some of the British colonies themselves. The causes of this, however, are not very far to seek, and when we remember how long and fiercely the principles of free trade were resisted in England, the excessive militaryism and consequent heavy taxation which prevails on the Continent, and the strong desire of the United States of America and the British colonies to foster manufacturing industries of their own, the slow progress of the movement is hardly to be wondered at. In all political and economical movements the forces of defence have great advantage over those of attack. Those who enjoy the benefits of a monopoly can easily band together and make their influence felt in politics, while the consumers, on whom the weight of the protection is laid, are of necessity less compact and more difficult to move.

The results of protection in most instances seem hardly satisfactory to the countries by which they are maintained, and the loudest complaints of foreign rivalry, and especially the rivalry of England, are raised in connection with industries which enjoy the largest measure of protection; while it may be observed, in conclusion, that in every civilized nation there is to be found a free-trade party who are busily engaged in the propagation and extension of their principles among their protectionist countrymen.

FREE'BOOTERS. See BUCCANEERS.

FREED'MEN (*libertini*) were a most remarkable class in the later Roman civilization. They were slaves (or the sons of such slaves to the third or fourth generation) who had been freed by the generosity of their masters or under the conditions of the Roman law. They were therefore the pick of the slaves—that is, of the business and literary part of the people, for art and commerce were pursued in general by the patricians through their means, few patricians being either their own merchants or scribes—and once free they often quickly rose to opulence and sometimes to power, while those destitute of intelligence sank into abject poverty. This mixture of a mendicant rabble and extremely rich parvenus, at once slaves as to their legal position with regard to their "patron," and free men, with no votes and yet hungry for power, thronged the capital to the great danger of the state at the close of the republic. It was in great part this dangerous class which supported the empire. The emperors found their safety also in using freedmen, men of no station and of low birth, though possibly of great talent and even learning instead of employing the great nobles. They could the more easily be thrown over when no longer wanted. A powerful noble might become dangerous. The freedmen of the emperors are therefore very prominent figures in later Roman history. Louis XI. of France used the same system of government with considerable success, being served by scarcely any person but those of mean condition, such as barbers, scriveners, &c. In England, when Edward II. tried it, however, it proved his ruin.

As a specimen of the wealth of these freedmen it may be mentioned that in the reign of Augustus one of this class who had suffered severely in the civil wars, nevertheless at his death left 3600 yoke of oxen, 250,000 sheep and goats, and 4116 slaves (Pliny's "Nat. Hist.")

FREEDOM OF THE WILL. "Are we free agents in this world, or are we the puppets of some unknown Will?" is one of the most momentous questions which has been asked of the human mind. The most natural answer is that we are certainly free agents and not puppets; for every one is conscious of mental deliberation and judgment in difficult situations, a deliberation often prolonged and intensely painful, and a judgment sometimes unswerving, sometimes hesitating, according to the convincing nature or otherwise of the evidence.

But a moment's reflection will show that the freedom is not quite so apparent. How if the will has to follow the law of cause and effect like all physical phenomena? Then a man in that sense is not *free;* he must as unavoidably lean to the side of the weightier evidence as a balance must descend towards the heavier body in the scales. If upon a given set of circumstances a man *must* decide in a manner known beforehand and predicable by any competent student, is he to be called free in his judgment? Can we call the stone free to fall when it has reached the topmost height in the curve it has received from a skilful thrower? We certainly cannot; it is bound to descend. If, then, the mind, by equally divine and universal law, has to obey the stronger side of evidence laid before it, does not a man's fate blindly depend upon the fortuitous nature of that evidence? Is a child free to lead a virtuous life who has never spoken to anyone but thieves and outcasts? Certainly not, the term would be a mockery in such a case. Every Christian would look upon the actions of such a one as the outcome of long-standing moral disease, as the actions of one who was not a free agent, but tied by the bonds of past generations till the pitifulness of mercy come to loose him.

Evidently, then, the problem that demands to be settled first is what we mean by the word *free.* The ancient Stoics declared that wicked men were slaves to their vices, and virtuous men free from this debasing bondage; and possibly this was the first aspect of the freedom of the will, an aspect surely accepted by all thinking men of all times. But this narrow limit to the word free was not destined to remain.

We have hitherto been stating for consideration the philosophical question as to the freedom of the mind; there is also a second point of view, namely, the religious question. This was stated by the Christian fathers of the second century, and their position culminated in Arminianism. Justin Martyr (A.D. 150) led the attack as part of his crusade against paganism. He challenged the Stoics as to their doctrine of fate. If, said he, everything is determined beforehand, sin is so determined, which is blasphemy; therefore it needs must be that sin is in the world through the free choice of man. Tertullian (160–220) goes further. He faces the problem of evil, for ever pressing man and for ever insoluble. If God is almighty he could have

ordered the world so that no sin was necessary to the completion of its scheme; and that being the case, why did he not do it? If he could not do it, he is not almighty; if he could, and would not, he is not all-good. The answer of humility is taught us by the ages, namely, that it is beyond the power of us poor creatures to debate the "why" of God's purposes, sufficient indeed if we may here and there find out portions of the "how." We say (or most of us do) that we trust our Father, that he has seen fit to permit evil, and that, therefore, though we cannot understand the reason of it, evil is necessary for his good purpose. We can indeed, and we do, cheerfully see the courage arising to face the tiger's claw, the triumph of engineering provoked by the fierce force of the storm, every virtue and skill dug out of mines of darkness, good in general arising out of evil, but we cannot, and cheerfully admit we cannot, tell why these good things could not arise from good—why, in fact, we were not made perfect without discipline. Tertullian shrinks from the dilemma he raises, and follows Justin Martyr in asserting, as the only way out of it, man's freedom to choose evil, and his unhappy choice thereof. Pelagius, the strenuous opponent of St. Augustine, followed this view in the fifth century, but got out of the difficulty of the omniscience of God involving his foreknowledge, by the tenet that man was free to choose good or evil, God knowing well what would be the result of his choice, but not interfering with that choice. This view was so powerfully set forth by Arminius, in Holland (died 1609), that it is generally known as the Arminian view. The soul's freedom to choose good or evil, then, is a cardinal tenet of Arminianism.

Exactly the opposite view had been taken by Calvin (1509–1564). The Calvinistic view of the free-will controversy takes its origin from St. Augustine, who laid down a perfect theological scheme upon the basis of predestination or Christian fatalism. Man was thus foreordained to be saved eternally or eternally to perish. His lightest act was controlled by God; freedom of his will was an absurdity. But against this doctrine men revolted, shuddering at its cruelty, and at the manner in which it imputed injustice to an all-good Father. For if a man is destined to sin, how can it be consistent with goodness to punish him? St. Augustine evaded this critical question by the doctrine of original sin. Adam had a free will, and Adam alone—he chose evil instead of good, and all men fell in Adam. Even this last softening of the terrible doctrine is rejected by Calvin, who also brushed aside the palliations of St. Thomas Aquinas, which so modify the doctrine as to explain away some of its chief terrors, and which form the orthodox Roman Catholic view. Calvin goes rigidly for election: the will of God, that alone governs man.

Returning to the freer air of the philosophers, we find Hobbes (1588–1679) clearly laying down the doctrine that the will "follows the last appetite," by which he means that after considering all the various inducements for or against an act, and successively rejecting them, a free man follows the one which remains. He defines a *free* man as a man at liberty to continue to deliberate. "Liberty," says he, "is the absence of all impediments to action which are not contained in the nature of the agent." Freedom from compulsion, that is; not freedom to choose against the balance of motives. In this sense our stone would be free. The opposite to a free stone would not be one which had the power to ascend against gravity after its force was spent, but would be one which by some fastening or attraction was held at the summit of its flight and prevented from fulfilling its natural course. So also Locke (1632–1704) says a man is free if his actions follow his mental motives, but he is not free when something external controls him to act against his motives. So again Leibnitz (1646–1716), to whom is due the fine distinction between the three kinds of fatalism. It was objected to these philosophers, with their doctrine of "necessity" (that the will necessarily followed from the balance of motives), that it was a veiled fatalism; whereupon Leibnitz pointed out that while the Kismet of the Mohammedans was a soul-crushing faith, which implied that an event must happen even if the proper cause were absent, the fate of the Stoic philosophers was an embodiment of the inexorability of nature, and was a dignified and proud faith; and finally that the uplifting and vivifying Christian fatalism rested trustingly in the will and mercy of God. Clarke and Reid somewhat feebly advocated the freedom of the will in the curious sense of some mystic *power* which one has over the determination of one's will. Sir William Hamilton (1788–1856), most powerful of Scotch metaphysicians, raised the question by a powerful review, inclining, though in his own peculiar style (resting on his "Law of the Conditioned"), towards the freedom of the will; and advancing as a recommendation of his views the argument that only by proving the freedom of the will could the existence of God be satisfactorily demonstrated. For if man has free intelligence, necessarily his creator must have free intelligence; whereas, apart from the mind of man, the universe could be conceived as atheistic, the result of blind necessary forces. For this attempt to return to the old question-begging phrases of the earlier disputants he was warmly reproved by John Stuart Mill, who also disposes satisfactorily of the Hamiltonian view.

The practically unanimous conclusion now come to is that the whole controversy is useless, and that it turns upon the ambiguity of the word free. It is absurd to complain of a man being bound by necessity to have every desire gratified, to carry into action every thought, to justly decide upon the higher motive; it would be fitter to rejoice that he was free to gratify his desire, to act his thought, to judge without bias. Both words are inapplicable to the question. A man is free when his will is able unrestrained to act upon the line of least resistance among the many motives that actuate him; that is, shortly, to act upon the strongest motive ("the last appetite," as Hobbes calls it); he is not free when he is so restrained. It may be asked—If, then, man must judge by weight of evidence, why do judgments so differ? Because of the difference of the characters of men. (A civilized man might require compulsion to make him eat his whole stock of food; a savage would carelessly do so if he were hungry enough.) This is evident by our constantly predicting what a man will do under such and such circumstances, provided we know his general character, otherwise we decline to predict. If we do not know of a man's virtue we cannot predict his conduct in the face of temptation.

Finally, here and there still lingers a feeling that if the will is to follow the law of cause and effect which rules all the rest of nature, men are not responsible for crimes. It is said, If a man is bound to be seduced by a sufficiently powerful allurement, is it fair to punish? Surely it is, if the fear of punishment is allowed to be (as it is) a very beneficent agent in strengthening the resistance to evil of the better parts of the character. Again it is urged, If a man is what his character and his circumstances make him, how can he ever improve unless you grant him some power over his will? What becomes of the phrase so often used, "You can do better if you will only try?" The philosopher replies that good men of themselves are among the circumstances surrounding a feeble soul, and that it is notorious that those who would never have courage to resist temptation alone, become brave against it when belonging to a society, signing a pledge, or wearing a bit of ribbon. The phrase challenged is by itself unmeaning one must admit; but the spur it gives is by no means unavailing. The knowledge of the feeble one that others think him stronger than he himself does lends tenfold power

to such strength as he has, and often is sufficient to turn the balance once and for all.

FREE'HOLD is the chief form of holding real estate (land) in England, the other form being COPYHOLD. Freehold tenure is that by which a man holds land in fee-simple, fee-tail, or for a term of life. The old feudal term is *frank-tenement*, a barbarous translation of the Latin term for freehold (*liberum tenementum*). Freehold is the descendant of the Old English BOC-LAND, and freeholders are the lesser "thanes" of the later kings before the Conquest. When the lesser thanes became the petty baronage of the feudal kings frank-tenement was distinguished from *free socage*. The first was a "knight's service," and entailed a readiness to obey the lord's call whenever necessary, with the stipulated number of men armed in the stipulated manner. The second was a farmer's service, to do so much work in the lord's fields, &c., during the year. But when feudal tenures fell through at the Restoration (1660) frank-tenement gave way to the less "noble" free socage, and freeholds became nearly all of the latter class. The custom of working in the lord's fields had long died out among the socagers, and the freeholders, while abjuring their knightly service, took good care not to revive the bygone incidents of socage. Nor did they contribute an equivalent for the military service, which they now thrust on to the shoulders of the state to provide. The king was contented with £100,000 a year instead of his feudal fines (reliefs, wardship, purveyance, &c.), and did not interfere when Parliament coolly imposed a war-tax on home commodities, invented by the Long Parliament as a permanent impost under the name of the excise duties. Certainly this proceeding of the freeholders was one of the most extraordinary ever contemplated by any nation.

From the Norman Conquest, or a little before, down to 1290 freeholders held either from the crown or from another freeholder; but at the latter date the statute "Quia Emptores" roughly and at once put an end to subinfeudation. When the king's and the lord's rights to service of a subvassal came into competition the lord, being at hand, often had the advantage over the distant royal superior. This statute therefore insisted upon the doctrine being actually carried out which the Conqueror himself had advocated — that all tenures should be direct from the crown.

From the earliest times all landholders in England had had the right of voting in the county court, the lineal descendant of the primeval free assembly of the tribe, where each man's vote was worth as much as his neighbour's. But it was found that the elections often resulted contrary to the royal views, and in Henry VI.'s reign, 1430 (8 Henry VI. c. 7), the famous disfranchising statute was passed, limiting the county franchise to freeholders whose freehold was of an annual value of 40*s*. From that time till now the "forty-shilling freeholder," notwithstanding the different value of the shilling, has remained the representative unit of English franchises. An Act of William IV. insisted upon the freeholder (with some few exceptions) actually occupying his freehold to be able to claim the forty-shilling franchise. But to remedy this somewhat a clause in the Reform Act of 1832 gave a franchise to *non-resident* freeholders whose freehold was of the annual value of £10; and in the Reform Act of 1867 this £10 annual value was reduced to £5 for non-occupiers.

Whereas the copyholder has some nominal service to perform to the lord of the manor, the freeholder is absolute owner of his property save only his duty and service to the king. It has been shown above how the chief service was got rid of by a legislative trick under the connivance of a worthless king, and the movement for a reconsideration of the position of freeholders as to taxation, and further, as to their right to hold the land *permanently* at all, is described in the article LAND LAWS. For an account of the ancient English theory as to the land see FOLC-LAND, BOC-LAND.

FREE-LANCES, in the feuds of the middle ages, roving companies of knights and men-at-arms who, after the Crusades, wandered about selling their military services to whoever would purchase them. See CONDOTTIERI.

FREE'MAN. See GUILDS.

FREE'MASONRY, which may be described as a peculiar system of morality veiled in allegory and illustrated by symbols, is an institution whose traditions date back to the time of King Solomon. It is said that the order took its rise from the building of the temple, on whose stones at the present day are found engraved the symbols which are common to masonic lodges. Its introduction into England is by some claimed for the Romans, and by others for St. Alban, who was the first who suffered martyrdom in this country for the Christian faith. St. Alban was a great friend to masons, and obtained a charter from Carausius, the Roman governor, to preside over a general council, at which many new members were received into the fraternity, and assisted in the building of many of the churches of the period. In the sixth century St. Austin placed himself at the head of the order, and founded the Cathedral of Canterbury in the year 600, that of Rochester in 602, St. Paul's in London in 604, and Westminster Abbey in 605. The masons were also employed in building castles, abbeys, and cities during the whole time of the Saxon heptarchy, and the fraternity found a zealous protector in Alfred the Great. In the reign of King Athelstan the Grand Lodge of York was founded, of which the king's brother, Edwin, became the grand master. This lodge, founded in 926, is the most ancient in England. With varying fortunes the masons were patronized by the sovereigns of England in succession, especially by those who were interested in the progress of architecture and the erection of those splendid buildings which at the present day are the admiration and delight of men. During the reign of Edward II. many of the colleges at Oxford and Cambridge were built by the fraternity under Stapleton, bishop of Exeter, who was appointed grand master in 1307. Edward III. revived and ameliorated the ancient charges, patronized the lodges and encouraged the order, which continued to flourish and to increase down to the time of Henry V., when Henry Chicheley, archbishop of Canterbury, was grand master. In 1425, however, during the reign of Henry VI., the masons entered upon troublous times. Beaufort, bishop of Winchester, did his best to influence the Parliament against the masons on account of the secrecy observed in their proceedings. In this the bishop was assisted by a portion of the clergy, who, thinking they had an indefeasible right to know all secrets by virtue of auricular confession, represented the fraternity as dangerous to the state. In later times the Church of Rome declared in emphatic terms against the fraternity, and subjected its members to the ban of excommunication. The position taken by a section of the clergy under Beaufort, however, was of only temporary disadvantage to the masons of that day, who were again received into favour on the death of the bishop. King Henry was himself initiated into masonry in 1442, and subsequently presided over the lodges in person, and used the masons in the building of Eton College and several of the colleges at Cambridge. The flourishing state of the order was interrupted by the Wars of the Roses, but revived under Henry VII., and in 1502 a lodge was formed in the palace, over which the king presided as grand master. On the accession of Henry VIII. Wolsey was appointed grand master, and was succeeded by the Earl of Essex and by other noblemen, till the office fell into abeyance in the reign of Elizabeth, when Sir Thomas Sackville accepted the office of grand master. On the accession of James I. to the crown of England masonry

flourished in both kingdoms, and Inigo Jones was appointed grand master of England, and continued in office till the year 1618. Sir Christopher Wren was also an illustrious mason, and a member of the Lodge of Antiquity for nearly twenty years; but during the Revolution masonry declined, and made no considerable progress till after the reign of Queen Anne.

The crisis had arrived in the history of the craft. It was determined that the privileges of masonry should not be confined to operative masons, but that people of all professions should be permitted to participate in them, provided they were regularly approved and initiated into the order. With this view the only four lodges at that time existing in London constituted themselves a grand lodge, and resolved to review the quarterly communications among the brethren. The original constitutions were established as the basis of the revised jurisdiction, and the ancient landmarks of the order were carefully preserved. But as "free and accepted" masons were admitted into the order, the tools and implements of the craft were used to illustrate the moral and religious duties of the new order of "speculative."

In the meantime masonry continued to spread in the north as well as the south of England, and after a time the Grand Lodge at York was united with the Grand Lodge in London as the Grand Lodge of England. From that time masonry made rapid strides, until it was universally spread over the face of the earth, admitting good men and true, who believe in the Supreme Being, into its mysteries and privileges. The tenets and principles of the order bear a high moral stamp, and in England political and religious discussions are alike forbidden in lodge assembled.

The primary organization of the masonic fraternity is into lodges, which must be composed of at least seven master masons of good standing. The first and lowest degree of masonry is that of entered apprentice, the second of fellow-craft, and the third of master mason. There are peculiar ceremonies at the making of each, and it is only on attaining to the degree of master mason that a brother enjoys the full benefits and privileges of the craft. The officers of a lodge in England are the master, his two wardens with their assistants, the two deacons, inner guard, and tyler. There must also be a treasurer and a secretary. A chaplain, a director of ceremonies, and stewards may also be appointed.

In the year 1884 there were 2000 lodges under the control of the Grand Lodge of England, including over 300 in London or its suburbs, about 100 in Lancashire, and others in the Channel Islands, India, Cape of Good Hope, West Indies, North and South America, Australia, New Zealand, &c. In the above numbers are not included lodges in Scotland or Ireland, each of which countries has its own grand lodge. In round numbers there are nearly 2,000,000 free and accepted masons scattered upon the face of the globe. Of this number some 250,000 are English masons, 130,000 Scotch, and 80,000 Irish. There are about 800,000 on the continent of Europe, half that number in the United States, and 70,000 in other parts of the world. In England several thousand persons are initiated each year, and the masonic body is everywhere largely increasing.

In the precepts of freemasonry brotherly love, relief, and truth hold a high place, and that the fraternity are not unfaithful to their trust is evidenced by their splendid charities. The Grand Lodge is in possession of large funds drawn from the dues of subscribing members, and poor and distressed masons, if deserving, are never left without adequate relief. The Grand Lodge in this way disburses from its benevolent fund several thousands every year. In addition the masons of England subscribe over £40,000 annually for the support of their three charitable institutions—the Freemasons' Girls' School, the Freemasons' Boys' School, and the Asylum for Aged Freemasons and their Widows. In the first 110 orphan girls are clothed, educated, and thoroughly provided for. In the Freemasons' Boys' School 100 sons of deceased freemasons are clothed, educated, and lodged. The institution for the relief of aged freemasons and their widows grants annuities to the old and infirm, and connected with it is a building at Croydon, where such of the annuitants as think fit are provided with rooms. So munificently, indeed, are the various charitable funds of the freemasons supported, that in 1877 the Grand Lodge was able, from its ordinary revenues, to vote £4000 for the establishment of two lifeboat stations, as a thanksgiving offering for the safe return of the grand master of England (the Prince of Wales) from India. Her Majesty the queen is patron of all the charities, and while the Prince of Wales, who was initiated in 1868, has been grand master since 1875, the Duke of Edinburgh and the Duke of Connaught are both members of the fraternity, and the late Duke of Albany held high office in the order at the time of his death in March, 1884.

FREE'STONE is a term applied by quarrymen to any stone which can be cut with equal facility in any direction; that is, in which there is no very strongly marked cleavage. Most freestones are varieties of sandstone.

FREE'TOWN or **ST. GEORGE,** the capital of the British settlement of Sierra Leone, stands on the north side of the peninsula of that name, and on the south bank of the Sierra Leone River, about 5 miles from the sea, on an inclined plane at the foot of some hills, on which are the fort, the barracks, and other public buildings. It is 50 feet above the sea-level at high-water mark, and regularly laid out in fine wide streets, intersected at right angles by others parallel to the river, all of which are ornamented with rows of orange, lime, banana, and cocoa-nut trees. Many of the houses are commodious and substantial stone buildings. The population is about 20,000. There are a church missionary grammar and other schools, a church, seven chapels, a lighthouse, a literary institution, a market-place, &c. The proverbial unhealthiness of the place is due partly to its inclosure by the mountain chain to which the colony owes its name, and partly to the decomposed vegetable matter which is brought down by the river and driven back upon the town by the tide.

FREI'BERG, an ancient city of Germany, and the centre of administration for the Saxon mines, stands on the Munzbach, a feeder of the Mulde, about 20 miles S.W. from Dresden, and had 25,110 inhabitants in 1882. It is surrounded by well-kept promenades, remains of the old defences; and the streets are regular, well built, and paved. The Freudenstein is an old castle, now used as a storehouse for mining produce. There are several churches, and the Dom Kirche or cathedral is a fine specimen of the architecture of the middle ages; it contains two elaborately cut stone pulpits, and has a richly ornamental portal called the golden door: the plastic decorations of it rank among the best works of the mediaeval period; near it is the tomb of the geologist Werner. There is also a chapel in which the Protestant princes of Saxony, from 1541 to 1694, were buried; and a remarkable monument with an alabaster statue of the Elector Maurice, who died of the wounds he received at the battle of Sievershausen, on the 9th of July, 1553, when he completely defeated the army of the Margrave of Brandenburg. Among the other buildings of note in the town are the town-hall, the high school, and the Berg Academie or Mining Academy. This last was opened in 1767, and comprises class and lecture rooms, a museum, in which are rich collections in mineralogy, &c., a geographical and a geological cabinet, a museum of models of mining machines and philosophical and chemical apparatus, and an extensive library. It owes its principal celebrity to Werner, appointed professor of mineralogy in it in 1775; his eloquence

and the charm of his manner inspired the greatest enthusiasm in his pupils, and besides raising the school of Freiberg to the highest eminence, and attracting to it students from the most distant countries, gave a great stimulus to the science. The manufactures consist principally of articles in imitation of gold and silver ware, brass wares, white lead, gunpowder, iron and copper wares, linen, woollens, gold and silver lace, ribbons and tape, leather and laces.

FREI'BURG, a beautifully situated town in the circle of the Upper Rhine, in the grand-duchy of Baden, stands not far from the right bank of the Rhine, on the railway leading from Frankfurt-on-the-Main to Basel, about 40 miles distant from the latter city, and had 36,400 inhabitants in 1882. The town, which has walls pierced by three gates, is in general well built, the Kaiser-strasse in particular being broad and lined with handsome houses. It has been the seat of an archbishopric since 1827. Among the remarkable public edifices are—the archbishop's palace; the grand-duke's palace; the government buildings; the courts of justice; the post-office; the old and the new university buildings; the town-hall, museum, granary, theatre, and house of correction. In the centre of one of the squares is a fountain surmounted by a statue of Duke Berthold III., founder of the town. The most attractive feature in Freiburg is the cathedral or minster, probably the most perfect specimen of Gothic architecture in Germany. It is the work of the twelfth century; the tower, which is 365 feet high, is peculiarly remarkable for its lightness and elegance. Connected with the university, which was founded in 1456, there is a library of 100,000 volumes, a museum, an anatomical theatre and clinical establishment, a botanic garden, &c. The town has also a gymnasium, a normal school, several other educational establishments, hospitals, and three orphan and foundling asylums.

The manufactures of Freiburg consist of leather, chicory, sugar, starch, powder, tobacco, soap, and potash. There are also bell foundries, gunpowder and paper mills, bleaching and dyeworks. In its vicinity are the fine gardens of Ludwigshöhe, the ruins of the Castle of Zæhringen, and many other spots admired for their picturesque beauty. Freiburg was founded in 1118 by Duke Berthold III.; it was long the capital of the landgraviate of Breisgau, and belonged successively to the house of Austria and to the Duke of Modena, being finally ceded to Baden by the treaty of Pressburg.

FREIGHT is a term applied to the charge made for the carriage of merchandise over sea. It is now also frequently used for the charge for the carriage of goods by rail, and also to describe the goods themselves. When goods are despatched by any ship, a document called the bill of lading is drawn up, specifying the ship, the quantity of goods, the freight, the destination, and other terms referring to the carriage of the goods, such as the time within which they are to be removed by the consignee, and damage. It also serves as an acknowledgment of receipt from the ship or shipowner. It is, however, very often nothing but a receipt, and refers for particulars of freight and other conditions to another document called the charter-party. This is nearly always employed where a ship is to be occupied wholly by the goods of one merchant, and always where a ship is let out for a period of time without reference to the cargo to be carried. In this case the freight is generally paid in a lump sum per month, reckoned on the measurement capacity or the guaranteed dead-weight carrying capacity.

It is generally stipulated in bills of lading and voyage charter-parties that the freight shall be paid by the merchant on the delivery of the goods, and the owner or master of the ship may demand payment of the same, package by package, as these are delivered. In almost all branches of trade, however, some custom has arisen which is generally followed. In London, where the greater part of the merchandise brought from foreign countries is delivered into the custody of one or other of the incorporated dock-companies, there is a custom of stopping the goods in their hands, subject to certain conditions, as to taking legal action within a certain time, &c., so that they cannot pass away from the original importer until the shipowner, or some person acting on his behalf, has signified in writing that the freight has been paid. Freight now occupies the position of any other debt, but a lien on the goods for freight, dead freight, and demurrage is generally secured by the shipowner in the bill of lading or charter-party. This enables him to retain goods in his ship until the amounts due to him on the above accounts are settled. Dead freight is incurred by the merchant when he fails to supply as much cargo as he had bound himself to provide.

FRÉJUS (the ancient *Forum Julii*), a town of France, in the department of Var, situated on a spacious plain, a mile from the Mediterranean and 15 miles S.E. of Draguignan, on the railway from Marseilles to Nice. The town contrasts painfully with its ancient condition. Formerly it was a league in circuit, was surrounded by strong walls flanked with towers, and had 40,000 inhabitants. Its amphitheatre, the outer circuit of which is 218½ feet, still exists in a ruined state. Its port, which was under its walls, and communicated with the sea by means of a canal 1¼ mile in length, was bordered by fine quays, the traces of which still exist, as well as part of a lighthouse, and a large triumphal arch which formed the entrance from the port into the town. The sites of the port and canal are now occupied by gardens. The present population is only 3135. The town and port were formerly supplied with water from the river Siagnes, by means of a fine aqueduct, 19 miles in length; this noble work is in great part destroyed. Numerous remains of antiquity may be seen in the neighbourhood. The town was a place of importance in the time of Julius Cæsar, who gave it his own name. Augustus sent thither the 200 galleys taken from Antony at the battle of Actium, made Forum Julii a naval station of importance, and planted in it a colony of soldiers of the eighth legion. Agrippa further devoted his endeavours to increase the prosperity of the town. Its strong fortifications protected it for a considerable period against the barbarians; but about the year 940 it was destroyed by the Saracens, nor has it since recovered so much as the shadow of its former prosperity. At St. Raphael, a little fishing village about 1½ mile from Fréjus, Napoleon disembarked on his return from Egypt, in 1799, and again embarked for Elba in 1814.

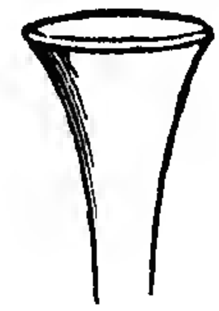
FRENCH BERRIES, the berries of the *Rhamnus infectorius* and other species, which are gathered before they are ripe. They afford a pretty but fugitive yellow dye.

FRENCH HORN, one of the most important and valuable, and certainly one of the most difficult, instruments of the orchestra. It derives its appellation of French from somewhat resembling the old French hunting horn or long thrice-curled brazen horn worn round the shoulder and across the body by the huntsmen of France and Germany. The English horn was a reed instrument, really a tenor oboe. [See COR ANGLAIS.] So long a tube (about 16 feet if stretched out straight) gave many natural notes (harmonics), and in consequence a large number of *fanfares* were playable on the instrument. These were much enjoyed by the huntsmen, and each one had his favourite tune. Each animal and each division of the chase had also its appropriate call, so that a listener could almost follow the hunt. The kings of France esteemed the instrument highly. Mr. Grove ("Dict. of Music") tells us how Louis XI. ordered his statue to be clothed as a huntsman with his horn beside him; and other kings, as Louis XIII. and Louis XV., invented fanfares of their own, the latter's selections being used to this day.

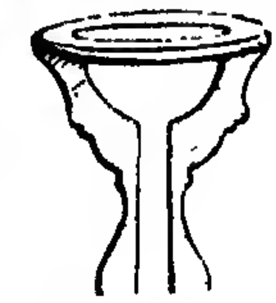
The hunting horn, though an instrument of so rich a compass, was not introduced into the orchestra till a comparatively late date. As it was used in the chase its tones were rough and noisy, and at first when it appeared in that state among the sweet violins and flutes it refused to blend with them. Soon, however, modifications were made, and it became and still remains a prime favourite for its wonderful faculty of binding together a body of varied tone, and sustaining the flow of a series of chords. Its first regular orchestral appearance is said to have been in 1757, when Gossec (inventor of the symphony) wrote parts for both horns and clarionets in the French opera; but as Bach's scores contain it, it evidently was known in Germany before that date, though we cannot point to a distinct date. As a wild instrument for special hunting effects Handel used it in London in 1720, but this was not fair orchestral use. Gossec having shown its capabilities, the instrument was greedily taken up; but its too-powerful tone still gave difficulty. Hampl, the famous Dresden horn-player, hit upon the expedient of softening the tone by partly blocking up the bell or wide orifice of the French horn. Truly the quality was softened, but at the same time the pitch was flattened by nearly half a tone. This was a most valuable discovery, for it at once gave the performer the power of producing sharps and flats as well as the natural notes of the key, and further it enabled him to correct certain irregularities in the Fourth and minor Seventh of the key which in the natural scale were out of tune with other instruments in the orchestra. Say, for instance, that with the horn in C the note F occurs. The F of the horn will be sharp to the rest of the orchestra. But partial insertion of the hand in the bell puts the horn for the moment into a slightly lower key, between C and C♭, and the harmonic F in this new key will be the F desired. On the same principle, carried further, a note can be flattened by an entire semitone.

The orchestral horn is modified from the old hunting horn of France, but still retains the name "French horn." In the first place it loses the great circle in which the *cor de chasse* is wound, and its outside curves, though still circular, are less in diameter, while the middle of the circle thus formed by the long tube is partly filled by a loop made of the central segment of the tube, turning inwards with a quick bend, and then bending back as sharply and continuing its circular course. This loop is cut across near its summit, so that into the two cut ends may be inserted the corresponding ends of crooks of various lengths of curled tube, whereby the total length of the instrument is increased or diminished. For, clearly, cutting across the loop is equivalent to cutting a small part out of the length of a straight tube, and inserting a crook is the same as inserting a junction piece between the cut ends, a longer junction piece making the whole tube longer and a shorter one making it shorter. By this contrivance the lowest tone of the horn, which is the tone given by its full length, may be altered, and as every note of the scale bears a distinct proportion to the lowest note, this means that the whole scale is shifted. The longer the whole tube (that is equivalent to saying the longer the crook used) the lower is the fundamental note produced, the shorter crooks giving higher fundamental notes. The best crooks are those which place the instrument in C, D, E♭, E, and F, and are respectively 105, 79, 68¾, 63½, and 55 inches long, the total horn being with the C crook 16 feet 3 inches long, with the D crook 14 feet 1 inch, and so on. A very large crook will even drive it down to B♭ *basso*, but this makes it difficult to play. Small crooks take it to G, A♭, A, and B♭ *alto*. These do not give so fine a tone as the lower crooks first mentioned.

The French horn has the richest, smoothest tone of any instrument of the orchestra. Though soft it is of wonderfully intense and telling quality, penetrating through every body of sound and binding it together in a way effected by no other instrument. It is probably the favourite instrument with Beethoven, whose horn-parts are miracles of beauty. The delicious and quite unique quality of the horn-tone, so entirely free from the *clang* of the trumpet or the *blare* of the trombone, is probably due to the shape



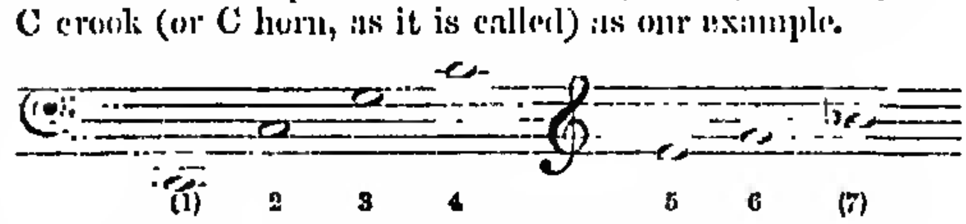
Embouchure of Horn.



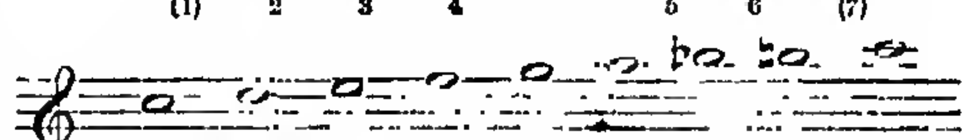
Embouchure of Trumpet.

of its mouthpiece. Trumpets and cornets, &c., have a cup-shaped mouthpiece, the French horn has a long conical mouthpiece.

Blowing in this mouthpiece, with compressed lips, the latter bulge into the orifice, filling the cup in the trumpet, pouting out into the tube in the French horn. The lips thus strained readily trill (a favourite amusement with very young babies is this trilling of the lips); that is to say, they allow the air to pass in a fluttering vibratory manner. In fact they have become a musical reed. Such a living reed vibrating at the end of a confined column of air will have its vibrations controlled into regularity by the column, and as soon as this control occurs a musical note is given; musical sound being nothing else than controlled and regularized noise or vibration. The note produced will of course be the note of the pipe, a longer pipe giving a deeper note, a shorter pipe an acuter note. A greater pressure the lip causes the next harmonic of the pipe to speak, the column of air now vibrating in two sections instead of as a whole, and a still greater pressure produces the next further harmonic (a vibration by three sections), and so on. All the harmonics follow exactly the same relative course, whatever be the length of pipe used. Change the crook and a fresh series are produced, but this fresh series among themselves have just the same relationships as the first. These relationships form the following scale, selecting the C crook (or C horn, as it is called) as our example.



(1) 2 3 4 5 6 (7)



8 9 10 (11) 12 (13) (14) 15 16

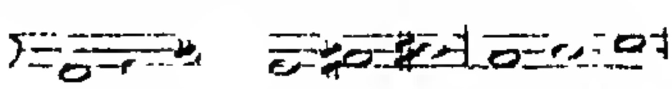
All these notes are producible from the one open tube of the horn, simply by varying the pressure of the lips. Of these the notes within parentheses, namely, the seventh (and of course its octave, the fourteenth), the eleventh, and the thirteenth, are out of tune with the ordinary (tempered) scale, and the first or fundamental tone is too deep to be obtained with an ordinary horn mouthpiece, though it can be sounded with a trombone mouthpiece. As the upper notes of the horn require a rather smaller mouthpiece and a more tightly drawn lip, horn-players divide into first and second horns; first horns rarely playing below 4 in the harmonic series, and second horns rarely above 10. First horns also in keys above F (as in G, A♭, &c.) do not rise beyond 12; and 2 and 3 become difficult for the second horn in low keys, as C and B♭ basso. Horn music is written, in accordance with these conditions, always in pairs, first and second horn going together, and third and fourth in like manner, should a sudden change of key in the course of a piece require another pair of horns to be tuned in readiness.

It has been mentioned that closing the bell, which is usually done with the open hand, flattens the tone, and at the same time alters its quality—muffling it, so to speak. The difference between closed and open notes is so great as to produce an inconvenient inequality of tone, and consequently the hand horn is frequently abandoned for the valve horn or slide horn. These instruments give the desired notes by a mechanism the result of which is practically to lengthen or shorten the tube by opening or closing certain cross passages from one bend of the crook to another, giving the vibrating column a short cut, or forcing it to take the entire length of the crook. In this manner a new scale altogether is temporarily obtained, just as if a new crook had been fitted; and the note desired falling in a different part of the new scale can be produced perfectly in tune. The general tone, however, of these valve or piston horns is not nearly so fine as that of the hand horn. Recently a slide horn has been invented, the requisite alteration in the length of the horn being produced by a bend in the crook which slides in and out (as in the well-known trombone-slide); and this promises to obviate all difficulty of intonation, while preserving the beautiful quality of the hand horn.

Speaking roughly, the same melody requires the same blowing, whatever be the crook employed. Thus, let a horn-player blow harmonic 8, then with a little greater pressure he gets 9, and with again a greater pressure 10. He will have produced the phrase

This would represent the actual notes sounded if the horn used were C *alto*, which, however, is a horn too high for useful playing. If the C *basso* crook were on, the performer, still playing as before, would produce the sounds

Similarly other crooks, always with the same blowing, would give the following results:—

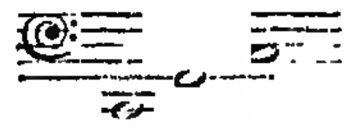
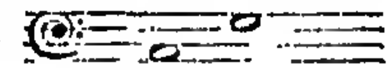


D crook. E crook. F crook. A♭ crook, &c.

Horn music is therefore written in the key of C, and in the treble stave: and at the beginning of the piece is written "horns in F," "horns in D," &c. (meaning that the performer is to fit his F crook, his D crook, &c.), as the composer requires—the horns being generally in the key of the piece. Or it may be, first and second horns in D, third and fourth horns in G, &c., when two pairs of horns are needed. As a consequence horn music is *never* written as it sounds, for the only crook which would give the power of so playing (C *alto*) is, as has been said, too high for the upper notes to be possible. The effect of the different crooks as regards the score is as follows:—

Horn in C plays an Eighth below written notes.
D " a Seventh
E♭ " a major Sixth
E " a minor Sixth
F " a Fifth
G " a Fourth
A♭ " a major Third
A " a minor Third
B♭ *alto* a major Second

The horn-player playing any melody on the C crook, and then the same melody (as far as his blowing is concerned) upon the B♭ crook, would give tones nearly an octave apart. And as if all this did not put sufficient difficulty upon the conductor, who has to transpose every note of the horn part to know its place in the general harmony, it is customary to write the first three notes (harmonics 2 3 4) an octave below their true place, thus—

 instead of 

There really seems no reason for this except a rather senseless custom.

It is little wonder that with so many difficulties in the way and so little to guide them, horn-players sometimes strike the wrong note in the harmonic series; but anyone patiently mastering the complicated details given above will become very forgiving to the French horns for an occasional trip. The horns in Weber's "Oberon," or "Der Freischutz," or in the exquisitely lovely "Notturno" [of] Mendelssohn's "Midsummer Night's Dream" music, or in nearly every orchestral piece by Beethoven, give a tender, sustained, rather melancholy intensity of effect which to most sensitive hearers is at times almost too full of pathos to bear; but such joys of melody do not often fall to the horn player's lot. He has nearly always to blow away bar after bar at the dull long notes which hold the whole mighty wave of sound together by the middle, connecting and harmonizing all the varying *timbres* of the orchestra.

FRENCH LANGUAGE. In the article France the subsection devoted to its history begins by tracing the complete conquest of the country by the Gauls, and the subsequent conquest of Romanized Gaul by the Franks. But though the original inhabitants were so utterly crushed by the Celts, and though the latter fell as surely before the Teutons, yet neither the one nor the other conquest succeeded in imposing its language, its religion, or it[s] civilization upon the country. These tasks fell to the Romans. Cæsar so thoroughly impressed the stamp of the Roman civilization upon Gaul that the Franks had to become French. They were as powerless to make Gaul German as were the Normans to make England French. In each case a few centuries saw the conquerors speaking the tongue and adopting the laws and religion of the conquered. Not so with the Roman conquest of Gaul. Within a century from Cæsar's campaigns Latin was spoken throughout Gaul; not the Latin of Horace and Virgil, but the Latin of ordinary Rome—popular Latin, not literary or classical Latin. In Littré's "History of the French Language," or Brachet's excellent "Historical French Grammar," which latter may be regarded as the handiest text-book on the subject (English trans. Oxford, Clarendon press, 1881), it is shown how upon the conquest of Greece and the fashion for Greek things which followed it, many Greek words and idioms were used in Rome to adorn the affected speech of the literary men and the patrician class. *Amphitheatrum*, *philosophia*, *geographia*, were strange and foreign words to the artisans in Rome, as much as or more than *diluvium*, *stratification*, *paleontology*, &c., are to those of to-day in London. These borrowed words widened the breach between the literary and the popular Latin, a difference which ever increased until the *sermo nobilis* became in Cæsar's day entirely distinct from the *sermo plebeius* or the *castrense verbum* (the speech of the common people or the language of the camp). Each had its own grammatical forms and vocabulary. For example, to strike is *verberare* in literary Latin, but *batuere* in popular Latin. The French words *cheval*, *semaine*, *double*, *bataille*, *baiser*, *chat*, *droit*, *feu*, *jeu*, *cour*, &c., do not come from the classical Latin *equus*, *hebdomas*, *duplicare*, *pugna*, *osculari*, *felis*, *jus*, *ignis*, *ludus*, *aula*, &c., but from the popular Latin *caballus*, *septimana*, *duplare*, *batalia*, *basiare*, *catus*, *focus*, *jocus*, *curtem*, &c. This latter was unwritten, and we might have remained ignorant of its existence had not the Roman grammarians revealed it to us by exhorting

their students to avoid its vulgarities. Thus Cassiodorus warns his students to describe the gladiatorial combats as *pugna*, not as *batalia* ("quæ vulgo *batalia* dicuntur"), just as we should direct a child to speak of a "fight," not of a "row." But as it was the soldiers and the rough agricultural colonists who were the Roman element in Gaul, it was the despised Latin of the camp and the field which overran the country, and became so thoroughly the language of the land that the Gauls were no longer regarded as barbarians. Nay, even as early as the first days of the empire, schools were founded (as at Lyons, &c.) that the upper classes among the Gauls might learn the literary Latin, used in all the numerous courts which began to dot the country; and Claudius, the fourth emperor, admitted many Latin-speaking Gallic nobles to the Roman senate. Gaulish Celtic almost disappeared. M. Brachet says:—"But few traces remained as evidence that it had existed. Thus the Romans remarked that the bird they called *galerita* was called *alauda* in Gaul; that beer, *zythum*, was *cervisia* in Gallic; they introduced the words into their own tongue, and these new Latin words, passing six centuries later into French, produced the words *alouette* and *cervoise*. These and a few other isolated words, together with names of places, are all that the French language owes to the Gallic." And as has just been said, even these rare Celtic elements have all passed through a Latin stage. We have to guess at the original forms of *Ligeris*, *Sequana*, *Matrona*, *Pictari*, &c., Celtic river-names and tribal names which passed from this Latin form (not directly in any one case) into the French *Loire*, *Seine*, *Marne*, *Poitou*, &c.

At the beginning of the fifth century the great invasion of the Teutonic nations overwhelmed Gaul. Some 12,000 determined barbarians held by sheer force a brutal sway over the 6,000,000, or thereabouts, of civilized Romanized Gauls and descendants of actual Romans. The literary Latin disappeared in the overthrow which for the time all forms of civilization suffered, and those of the clergy or the lawyers who dimly remembered it concocted out of their memories and the common tongue the remarkable mixed jargon called "Low Latin." This professional language, dimly paralleled by the Norman-French of our English law proceedings in the earlier centuries after the Norman Conquest, being neither one language nor the other, nevertheless lingered on till the time of Francis I., who caused it to be abandoned in favour of French proper. As said before, the Franks failed utterly to impose their characteristics upon the conquered nation, and when Clovis became Christian the triumph of Latin, which was the language of the one only Christian church of the west, was assured. In only two centuries after that time bishops are chosen because of their knowledge of the new language called Romance, which under the new life of the Merwing Frankish dynasty (Merovingians) had arisen from the modification of the vulgar Latin speech of Gaul. In 659 St. Mummolinus was chosen bishop of Noyon because he knew both Teutonic and Romanic. In the eighth century the Romance eloquence of St. Adalbert is lauded, and glossaries of Latin and Romance and of Teutonic and Romance appear. The famous Strasburg oaths sworn before the Karling army (Carlovingians) in 842 show that German was no longer understood by the common Frankish soldiers, although the great Karl himself (Charlemagne) had vainly endeavoured a few years before to attain fluency in Romance, so rapidly did matters progress. These oaths, sworn between the brothers Hlodowig (Ludwig) and Karlus (Charles the Bald), begin thus:—"Pro deo amur et pro christian poblo, et nostro commun salvament, dist di in avant," &c. (For God's love and for his Christian people's, and for our common salvation, from this day henceforth), which although not yet truly French is so near it as to be at once legible. And in 911 when the Norseman, Rolf the Ganger, swore fealty for Normandy to Charles the Simple in antique German, the guttural sounds set all the court laughing, though it had been the language (or nearly so) of their grandfathers. But while German thus failed to hold back the development of French and of the popular Latin, it was by no means without effect upon it. With the new forms of government, and the other results of the Frankish domination, large numbers of Teutonic words were associated. Terms of the law, of the court, of the camp, are in French, principally of Frankish, not of Romance origin; 900 such words are counted which travelled through Latin into French. Such words as *échevin*, *sénéchal*, *haubert*, *guerre* are in ultimate origin Teutonic. Latin was for some time yet cultivated by the church and the nobles; but when the Karlings fell before the mayors of the palace, Latin had so far sunk into the background, and French had so far developed, that the great Hugh Capet spoke French alone.

By this time, owing to the mixture of races which held France—the Franks, Burgundians, &c., chiefly to the north, and the more undisturbed original races to the south—considerable diversities had arisen. In each division it was by a different manner that French had developed out of popular Latin. And since the word "yes" was *oil* in the north and *oc* in the south, the two main groups of dialects received the name of the Langue d'Oil and the Langue d'Oc respectively. The latter name is preserved in the large division of France still called Languedoc. The Langue d'Oil had four chief varieties, the Norman, Picard, Burgundian, and French (speech of the Ile de France); and since the central position of the latter and the rise of the Capets (dukes of France) to the nominally supreme power gave it prominence, and since this position was used to the full by sovereign after sovereign with great ability, until Louis XI. was practically master of all France, the particular variety of the Langue d'Oil called French distanced all its rivals. The latter forms of French remained as *patois*, all courtiers and noblemen perforce talking the language of the sovereign. To this day, however, French is the language of less than half France.

The expeditions into Italy of Charles of Valois, of Charles VIII., Louis XII., and Francis I., &c., filled France with the new birth (renaissance) of literature and art which Italy had originated, crowding French with Italian words and phrases (*soldat*, *carabine*, *infanterie*, &c., *courtisan*, *carosse*, *balcon*, &c.) The marriage of Catherine de Médicis powerfully aided this new source of wealth. Another fountain of new words, though yielding much temporary result, produced but little permanent effect; this was the work of the school of Ronsard, &c., who aimed at purifying the tongue by returning to what they thought the true Latin forms, as for instance preferring *pérégrin* to *pèlerin* (as being closer to *peregrinus*), *faction* to *façon*, &c. We have a corresponding attempt in English at about the same time in Lyly's "Euphues," and a little later more markedly in Sir Thomas Browne. In each case the popular form has outlived the scholastic, for the simple reason that differences of climate, of the physical conformation of the vocal organs, &c., had produced the variations most appropriate to the new soil whereon the language was born afresh. To replant original roots was but to begin the same process anew.

Finally, the assistance claimed and rendered from the Spaniards in the times of the civil wars of religion brought with it a moderate influx of Spanish elements which took permanent position in the language.

In 1694 was begun the monumental Dictionary of the Academy, which set up as its aim to fix and maintain the purity of the French language by permitting no further innovations. That dictionary has had to suffer numberless revisions, and has not as yet got half through the alphabet. If ever it reaches the close of its task it will probably deal with a dying or dead language, for

French is a growing tongue. Indeed the amount of the last addition named, the Spanish, is not so great as that of a later addition still, the product chiefly of the present century, that namely from our own tongue—English. Le turf, le high-life, le sport, le gentleman, le squire, le confortable, le rosbif, le plum-pudding, le train, l'express, le tunnel, le dock, le jury, le budget, le clown, le touriste, such are only a few of the crowd of terms which English sports, machinery, home life, and politics have carried with them into France among their French admirers.

But little space can be spared for the consideration of the deeply interesting branch of the subject which deals with the actual manner in which the Latin has become French. The three main principles which may now be traced as having governed this transition, although of course they were followed quite unconsciously by the people themselves, are these:—First, the maintenance of the accent of the Latin word intact, then the suppression of the short vowel, and lastly the loss of the medial consonant. Thus as to the accent, from *amorem* we get *amour*, from *angelus* we get *ange*, from *organum* we get *orgue*. (At the same time we find also *angelus*, *organe*, in French, terms due to later Latinizing propensities of the learned, several coming from the clergy, several from the school of Ronsard and Du Bellay, but most from the scientists of the present day.) Then, as to the suppression of the unaccented vowel preceding the accented syllable, we have *blâmer* from *blasphemâre* (see also the "learned" *blasphémer*), *sembler* from *simulâre*, &c. And as to the omission of the Latin medial consonant in ordinary French we have *douer* from *dotare*, *lier* from *ligare*, &c. Learned French retains this medial consonant, as in *doter*, *liguer*, corresponding to the examples given. One word, and one only, from its importance and its very puzzling nature, may be selected for explanation out of those few which do not simply follow the above rules. That is the pronoun *je*. It seems at first as if the Latin *ego* (I) could hardly become the French *je*. We find, however, that in the famous oaths of Strasburg (A.D. 842), before referred to, the pronoun I appears as *eo*, that is *ego*, which by softening has lost its *g*. In later writers *eo* (pronounced *ay-o*) becomes *io* (pronounced *ee-o*), as in Villehardouin, &c.; and still later *io* becomes *yo*, and then *jo*. So the town Divionem (always taking the accusative of the Latin noun rather than the nominative) becomes *Diyon*, *Dijon*. From *jo* to *je* is not a long step theoretically, and indeed was actually very quickly made.

Certain differences from Latin are very remarkable. For instance the French drops the neuter gender, and makes all its nouns either masculine or feminine. It simply turned Latin neuters into French masculines, as *collegium* into *collège*. Some words (as those in *eur*) are feminine in French though masculine in Latin, and the Ronsard school laboriously wrote *le chaleur*, &c., to recover the true (Latin) gender. Their labour was in vain, however, except as to *honneur* and *labeur*. Then also we remark that the six cases of the Latin noun and adjective are reduced to one invariable case in the modern French. But there is a very curious intermediate stage in old French, where we find two cases, the nominative and the accusative, or more exactly, the subjective and the objective. Thus *li* answers to *ille*, *le* to *illum*, *murs* to *murus*, *mur* to *murum*, and in the thirteenth century men said *li bons murs est haut*, but took care also to say *j'ai vu le bon mur*. By the following century *le* is made to do general duty for *li* and *le*, *bon* for *bons* and *bon*, and *mur* for *murs* and *mur*. There is a peculiarity about the adjective *grande*. In Latin *grandis* is at once masculine, feminine, and neuter; and this invariability was followed in old French, the one form *grand* serving both as masculine and feminine. When the fourteenth-century changes came, *grand mère*, *grand faim* seemed to be wrongly used for *grande mère*, *grande faim*, and *grand* was therefore equipped with a feminine *grande*. So with other adjectives properly invariable, as *mortel*, *cruel*, &c. *Grand*, however, in such expressions as are above given, has stoutly resisted the change though all the others have given way; but later grammarians are ignorant enough to insist on an apostrophe being used, and it is therefore now usual to write *grand' mère*, *grand' faim*, as if a feminine *e* had been dropped out. The whole subject is full of curious and absorbing interest, but to do more than indicate some of the chief remarkable points, in such a way as has been above attempted, would lead beyond the limits of an article.

FRENCH LITERATURE. *First period: anterior to Francis I.*—The language of Northern France was the Langue d'Oil [see FRENCH LANGUAGE], and the poets who wrote in the Langue d'Oil (d'Oui) were called *trouvères*. The persecution of the Albigenses, whose tenets were embraced by many of the troubadours, poets corresponding to the trouvères, but writing in the Provençal Langue d'Oc, led to the gradual decline of the Provençal language; while the establishment at Paris of the seat of government and of a university, rendered the Langue d'Oui predominant throughout France.

The French drama arose out of the custom of pilgrims singing rude songs, and making recitals of the life and death of Christ, and other sacred subjects, at the various places of pious resort. In 1402 Charles VI. authorized these exhibitions by letters patent; stages soon arose in every province, and the *mystères* became very popular. Among the French, as elsewhere, the Passion was the most constant and most solemn subject of these representations.

The literature of this period contains vast numbers of epic poems, especially on Arthurian legends, of satires, as Reynard the Fox, &c., of fabliaux, and allegorical romances, as the Romance of the Rose—all in constant process of growth and development under the hands of successive poets till they attained almost unwieldy proportions, but many of them most powerful and interesting to this day.

Among the earliest prose writings in France are "Mémoires," a kind of literature peculiar to the French, the commencement of which dates from the thirteenth century. The writers of this class whose names are best known to us, are Geoffrey de Villehardouin, Jean de Joinville, Olivier de la Marche, Philippe de la Marche, Philippe de Comines, and Froissart. Of poets Villon is incomparable, and Charles, duke of Orleans (who wrote also in English, which he learnt in captivity under our Black Prince), is specially fine in the "rondel." Alain Chartier, somewhat earlier in date, is best known by the kiss of Margaret of Scotland on his sleeping lips. She, a poetess, reverenced the lips whence flowed such sweet harmony.

Period 2nd: from Francis I. to Louis XIV. (1515-1643.)—Under Francis I. the study of the Greek and Roman authors began to spread in France; the French writers attached themselves to the imitation of the ancients, and thus arose the so-called modern classical school.

The poets of this period included among their number Francis I., Marguerite de Valois, Mary Queen of Scots, and Henri Quatre; but the poets whose names are better known as such, were Clement Marot, Etienne Dolet, Ronsard, Jodelle, Baif, Du Bellay, Du Bartas, Regnier, Des Roches, Bertaut, Racan, Gadolin, and Malherbe. The French language acquired force and terseness through the writings of Rabelais, Ronsard, Amyot, Voiture, and Balzac the elder.

Among the historical writers of this period, Theodore Agrippa d'Aubigné wrote a history of his own times. Blaise de Monluc, Michel de Castelnau, the delightful gossipping Brantôme, La Popelinière, Beza, Sully, Serran, and Bodin were also historical writers of this period. The moralists included the unrivalled Montaigne, Etienne de la Boétie, and Pierre Charron; Ramus, Viéta, Belon,

Olivier de Serres, and others, wrote on various branches of science.

Period 3rd: Reign of Louis XIV. (1643-1715.)—We now come to what the French call the golden age of their literature. Among the poets of the period were the fabulist La Fontaine, the satirist Boileau, and the pastoral writers, Fontenelle and Madame Deshoulières. In this reign the romance of chivalry changed into a sort of historical novel, of which Fénélon and Mademoiselle de Scudéri were the chief writers. Other novels and fairy tales introduce us to the names of Bussy de Rabutin, Perrault, Galland, Hamilton, Scarron, and Le Sage; while Madame de Maintenon, Madame de Sévigné, the Comtesse de Staal, and Ninon de l'Enclos, have left admirable specimens of the epistolary style.

It was under the rule of Cardinal Richelieu that Corneille commenced writing plays, during the period now under notice. He adopted the classical style of the drama, and wrote those masterpieces known to all readers, "Polyeucte," "Rodogune," "Le Cid," "Les Horaces," "Cinna," &c. The French comedy, of which Molière is the great representative, delineated human character after a fashion unrivalled in its own style. Racine became the favourite tragic poet of the court of Louis XIV., carrying the classical style to its consummation in "Iphigénie," "Phèdre," "Esther," "Athalie," &c.

Among the prose writers of this long reign were the philosopher La Bruyère; the satirist La Rochefoucauld; the theologians Bossuet, Bourdaloue, Massillon, Saurin, and Pascal; the historians Mezeray, Rollin, Basnage, Fleury, De Retz, Ducange, and St. Simon; and the metaphysicians Descartes, Malebranche, Gassendi, and Bayle. The Academy of Sciences, founded by Colbert in 1666, greatly contributed to the progress of mathematics and natural philosophy, by encouraging the labours of such men as Pascal, Fermat, Descartes, Vauban, and Tournefort.

Period 4th: Louis XV. to the Revolution (1715-89).—The principal writer of the eighteenth century, who may be considered as the representative and the personification of the age, is undoubtedly Voltaire, one of the very greatest and most versatile literary artists who ever lived. Next to him was Rousseau in respect to the enormous influence exerted over his readers. Diderot, D'Alembert, Helvetius, Grimm, and Holbach, with the "Encyclopédie" for their organ, contributed to the diffusion of sceptical opinions. The first-named was the editor of this important work. See ENCYCLOPÆDIA, DIDEROT.

The historical works of Voltaire, and the dissertations of Montesquieu, had a marked influence on the study of history. The knowledge of antiquity was advanced in various ways by D'Anville, Caylus, and Montfauçon. The results of Rousseau's writings on education, on style, and above all on politics, are not only to be read in the lurid flames of the French Revolution, but form the basis of the French character to this day to a surprising extent.

The eighteenth century was still less poetical than the age of Louis XIV. The model was Voltaire, and particularly his poetical or rather versified tales. In tragedy Voltaire was almost alone. His authority in matters of literary style and taste is yet paramount in France. The novels included the works of Marmontel, Florian, Bernardin de St. Pierre, and Crebillon.

The mathematical and physical sciences made great progress in France during this century. It is sufficient to mention the names of D'Alembert, Lagrange, Monge, Lalande, Lacaille, Maupertuis, Clairaut, Camus, Lemonnier, Celsius, and Condamine, to show the richness of this department; and the natural sciences were ably represented by Buffon, Bonnet, Réaumur, Brisson, Vicq d'Azyr, Jussieu, Deluc, and Saussure.

Fifth period: from 1789 *to the present time.*—The most popular poets have been Lamartine and Victor Hugo. Béranger's witty and truly national songs are unsurpassed in any tongue. Casimir Delavigne acquired his reputation chiefly by his dramatic productions. Beaudelaire and De Musset carry intensity of expression to as high a point as it has ever attained.

The theatre absorbs much of the talent of France; and the best recent writers in this department have been Victor Hugo, Alfred de Vigny, Madame Dudevant (George Sand), De Musset, and Dumas the elder and younger. Later men are Angier and Ponsard, worthy continuers of the best traditions of the Theatre Français.

Among the earlier prose writers Châteaubriand was one of the most popular, both in France and abroad. Madame de Staël was scarcely less popular. The religious works of Rénan, and the critical studies of Taine, have obtained, in our own day, world-wide reputation. Among the somewhat earlier philosophical and critical writers we may instance Victor Cousin, Montalembert, and Lammenais; while socialism has been advocated by Comte, St. Simon, and Fourier. In jurisprudence, De Tocqueville made an epoch; and Champollion, Rénan, and Remusat in philology. In mathematics, Lagrange, Biot, Ampère, and Arago stand unrivalled. Among the scientific names must be included those of Cuvier, St. Hilaire, Gay-Lussac, Claude Bernard, Brown Séquard, and a host of others. The most distinguished historians are Guizot, Sismondi, Thiers, Michelet, Louis Blanc, Lamartine, Villemain, and Martin.

The class of novels contains the most remarkable powers of France with the exception of the drama. To mention Alexandre Dumas and his son, the incomparable and voluminous De Balzac, George Sand, Mérimée, the exquisitely polished De Musset and Gautier, and chief of all the Second Empire novelists, Flaubert. The "Madame Bovary" and the "Salammbô" of the latter are miracles of finish attained by long years of work. But the style of novels now prevailing in France forms a literature which exerts a very marked and sometimes pernicious influence on French society. Avoiding shameless and flagrant indecency, many of them throw just so much flimsy drapery over vice as serves to stimulate the sensuality of their readers. The disasters of the war of 1870-71 arrested for a moment the full swing of gross dissipation, and there came a dismal reaction of despondency. The leaders of the fashionable world, and the writers who had ministered to their immorality, turned hysterically to masses and pilgrimages. The penitence and vows of reformation, however, were quite temporary. The war over, the indemnity discharged, and the occupied provinces evacuated by the enemy, the reign of immodest literature speedily recommenced. Of this school are Daudet, the repulsively naturalistic Zola, and the like. Recently, however, signs have not been wanting that the limits of endurance of immodesty have been reached; and subjects of purity and grace are selected by the best of the younger writers.

FRENCH POLISH, a varnish for wood made by dissolving some resinous substance, as shellac, in spirits of wine, and designed for polishing furniture, by being rubbed in with soft rubbers made for the purpose. The polisher works his rubber in large overlapping circles, so as to spread the gum evenly over the whole surface. It is necessary to moisten the rubber with a little linseed oil to allow it to rub without tearing up the polish already smeared on. When a sufficient body has accumulated the work is allowed to stand and harden, and the smears of the oil are then cleaned off with spirit. French polish is usually tinted in accordance with the wood to be decorated. For rosewood a little red colouring is added, for instance, to heighten the natural tint of the wood. For white wood bleached shellac is used, in order not to tint the wood.

FRENCH REVOLUTIONS. The first French Revolution, that of 1789, which is always meant when the French Revolution is spoken of, will be found briefly

sketched in the article FRANCE, and more fully in the articles CONSTITUENT ASSEMBLY, REPUBLIC (FRENCH), CONVENTION (THE NATIONAL), REIGN OF TERROR, COMMITTEE OF PUBLIC SAFETY, DIRECTORY, CONSULATE, and in the articles on MIRABEAU, ROBESPIERRE, DANTON, and the other greater revolutionaries. The revolution of 1830 (the "three days of July") will be found described in CHARLES X. and in LOUIS PHILIPPE; and that of 1848 in LOUIS PHILIPPE and REPUBLIC (FRENCH). The coup d'état of the prince-president (Napoleon) in 1851 is treated of under NAPOLEON III., and the counter-revolution of 1870 (if so quiet a movement deserves that name), reinstating amidst the ruins of the second empire that republic which the Emperor Napoleon III. had destroyed, is described in FRANCE and in REPUBLIC (FRENCH).

FRENCH SIXTH, one of the varieties of the AUGMENTED SIXTH, namely, that in which the chord consists of the minor Ninth of the dominant with the major Third and Seventh of the supertonic—together with the supertonic itself. Thus, in the key of C (the dominant being G and the supertonic D), the dominant minor Ninth is A♭; the Third and Seventh of the supertonic are F♯ and C, and the chord of the French Sixth occurs as under:

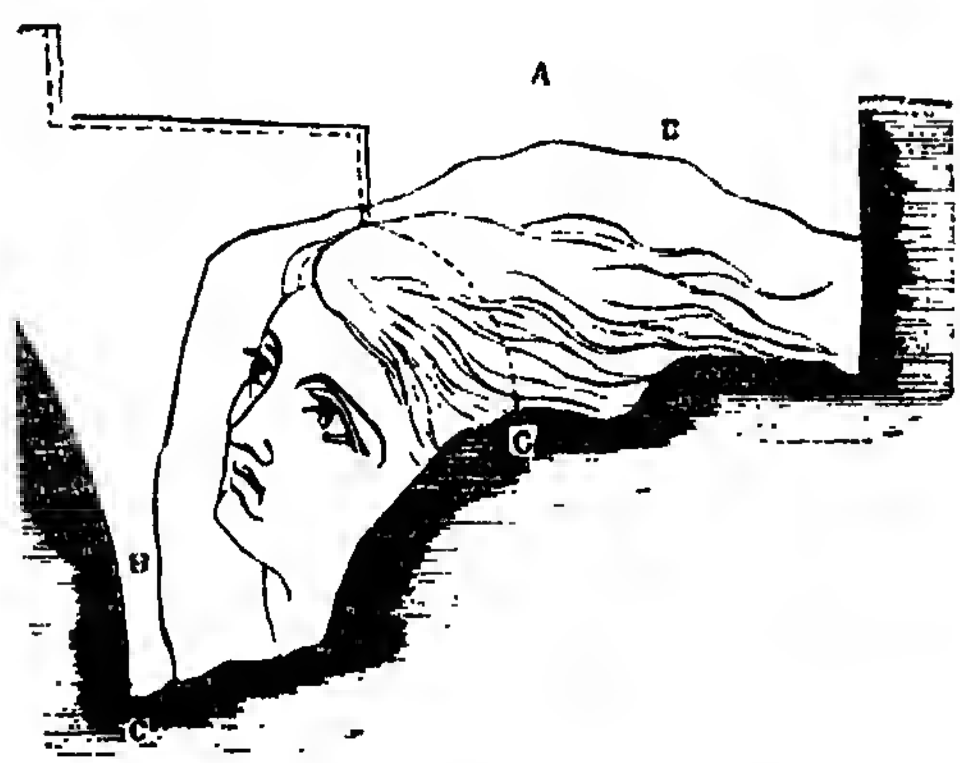
Key of C. "French Sixth." Its Resol

If from the French Sixth the supertonic is omitted (the note D in the first chord of the illustration) the chord is called the Italian Sixth. These names are now becoming antiquated, and sometimes puzzle the younger generation of musicians.

FRENCH TREATY, the name specially given to the treaty of commerce between Great Britain and France, signed at Paris, 23rd January, 1860, by Lord Cowley and Mr. Cobden, and MM. Baroche and Rouher. It was agreed that England should withdraw the import duty on gloves and silks, and reduce that on wines—the French, on their part, agreeing to reduce their duties on British manufactures to a very considerable extent. The beneficial results of the treaty were much felt in Great Britain during the depression of trade caused by the American civil war of 1861–65; but another severe depression which took place in 1869 was attributed to it by many short-sighted persons, on the ground that it was not sufficiently reciprocal, and meetings were held against it in various parts of the country. A few trades—especially the ribbon and silk weaving of Coventry and Spitalfields—were undoubtedly injured by it; but exactly the same thing happened in France, as the cotton weavers of Rouen were unable to compete successfully with those of Manchester. In France, however, the treaty had always been opposed by the protectionist party, of whom MM. Thiers and Pouyer-Quertier were the chiefs; and in 1872 notice was given by them that France would only be bound by it for another year. In the following year wiser counsels prevailed; and another treaty was signed by which the provisions of that of 1860 were continued until 1882, since which the United Kingdom has been placed under the "most favoured nation" clause in its commercial relations with France.

FRESCO. A painting is said to be a *fresco*, or painted in fresco (*sul fresco intonaco*, upon the fresh coat), when it is executed in water colours upon wet plaster. Fresco is the most noble and imposing of all methods of painting. *Colouring* in fresco was practised by the ancients, though it has not yet been shown that they *painted frescos*. Vitruvius (vii. 3) explains the mode of preparing the walls for this species of colouring, and describes the method of varnishing them when coloured to preserve them. The earliest Italian frescos are in the church of Assisi, in the cathedrals of Orvieto and Siena, in the Campo Santo at Pisa, and in San Miniato and Santo Spirito at Florence. These and other later frescos are painted on four different kinds of walls; in the old Gothic buildings, on ashlar walls covered with a thin coat of plaster; in more recent buildings, on brick and rubble walls; and in some of the most recent edifices, on lath covered with various thicknesses of plaster. The best preserved of these frescos are on brick. There are many frescos at Pisa, Florence, and Venice on lath, and all are in tolerable preservation. Among the most famous frescos are those executed by Michael Angelo on the ceiling of the Sistine Chapel in Rome, one of the most beautiful of which (the "Delphic Sibyl") forms the illustration of this article. See Plate.

The method of plastering the walls for painting has been nearly uniform in most ages. The walls of the baths of Titus at Rome are covered first with a layer about half an inch thick of coarse sand and lime; above this a thick layer of lime and pozzolana with an admixture of sand and pounded brick; the third and upper coat is of lime and pounded marble. The third loggia of the Vatican, painted by Giovanni da Udine, is much the same as this. The selection of the limestone to be employed in fresco-painting, both for the ground and for the white, is a matter of great importance; it should be nearly pure carbonate of lime, and should contain as few foreign materials as possible. If the lime is used too fresh it blisters, and sometimes turns the colours to a brownish-red. The lime for the *intonaco* in fresco-painting must not be entirely carbonated, or it would not set; a certain degree of causticity is necessary. The picture must be executed while the *intonaco* is wet or soft; no more work therefore ought to be commenced than can be completed within the time (a few hours) that the



Example of the Method of Working in Fresco.

A, The entire space above the dotted line is painted in one day, and the flowing hair included, the cut being made at the dotted line, C. The line B B represents the joining that less careful artists might have made. C C, Boundary of another day's work.

plaster requires to harden. Numerous joints are thus necessary in a large fresco, and the judicious painter will contrive that these joints shall be identical with the inner outlines of the parts of the figures and their draperies, or any other object, so as to be no disfigurement to the work. Before laying on the *intonaco* the prepared ground must be repeatedly wetted, until it will absorb no more; then a thin moderately rough coat of plaster of sand and lime must be laid over as much of the wet surface as can be painted in one day; as soon as this coat begins to set, in about ten minutes or so, another thin coat must be laid on with a wooden trowel, both layers together being scarcely a quarter of an inch thick. Upon this coat the fresco is to be painted. This *intonaco* will be fit to paint upon in

about a quarter of an hour. The first process in executing the picture is to pounce or trace the outline of the allotted work, then the painting may be commenced in thin watery washes from the finished coloured sketch. After the first wash is finished an interval of twenty or thirty minutes should be allowed for the absorption of the water before commencing the second painting. While the *intonaco* is wet a repetition of the same tint will have the effect of a darker tint, as in tempera drawing. The surface must be constantly kept moist (but not wet) while painting, or the superadded colour will not unite with what is beneath. When the portion of the picture allotted for the day's work is completed, the superfluous portions of the *intonaco* should be carefully cut away. In the next day's operation the surface must be wetted as before, and the edging of the finished piece carefully moistened with a brush. If it should be necessary to leave the work for an hour or two, it may be kept moist by pressing a wet linen cloth against it.

The colours used in fresco-painting are all ground and mixed in water, boiled or distilled. Before being applied to the wall they must be mixed with white, that is, with lime, which may be considered the vehicle or means of attaching them to the ground.

The method of *fresco-secco*, or dry fresco, is thus practised:—The plastering of the wall having been completed, the whole is allowed to dry thoroughly. Before painting, the surface of the *intonaco* is rubbed with pumice-stone, and on the evening of the day before the painting is to be commenced it is thoroughly washed with water mixed with a little lime; it is wetted again the next morning, and is then ready for pouncing or tracing the outline, and painting; the wall must be kept constantly moist by means of a syringe.

Frescos are sometimes cleaned by dry bread; sometimes by pure water, by vinegar, and by wine. Ingenious modes have been devised of removing frescos from walls, and transferring them to canvas.

Some progress has been made in the Houses of Parliament at Westminster in decorating some of the halls with frescos (since 1850 onwards); but the anticipations of those who believed that these works would influence the public taste in the direction of monumental and historical painting, cannot be said to have been realized. This is discouraging. It may be remarked, however, that since these works were commenced, British artists have paid more attention to the study of form than was previously the case. Several of the works in fresco which have been executed exhibit merits of a high order, proving that in the present British school of painters there are artists equal to success in the highest walks of art; and when the entire novelty in this country of the method of painting is considered, and that the artists who have been employed practised it for the first time when their style of painting in another material had been formed, we can hardly sufficiently admire the energy and ability which have been displayed. Unfortunately, many of these works already exhibit symptoms of early decay. This no doubt is to be attributed partially to want of experience on the part of the artists, to the conditions under which the frescos have been executed on materials previously untried, and to the smoky atmosphere of London. It is apparent that the beautiful art of fresco-painting is unsuited to the climate of our great cities without precautions as yet undiscovered; and it seems probable that immovable wall paintings of any description not readily cleaned are inexpedient in an atmosphere impregnated with soot, and which in so few years blackens and injures every surface exposed to its action.

Fresco-painting, however, may be adopted even in its present state by washing, for instance, in the decoration of our great country residences, where the same deleterious influences are not at work; and such frescos might endure for centuries in favourable situations. Indeed the art is already gradually extending.

Some remarkable works in fresco by the method of M. Gambier Parry, called *spirit fresco*, have been done by Sir Frederick Leighton, president of the Royal Academy, at the South Kensington Museum. These noble works, "The Arts of Peace" and the "Arts of War," are of large size, and serve therefore as an excellent test. Up till now their tints remain in the president's well-known brilliant and harmonious colouring; and there is every reason to hope that the invention has overcome the apparently insuperable difficulties attending water fresco in England. The plaster here is worked on quite dry. It is saturated with an essential oil, and the colours are then painted in a spirit medium upon the soaked surface. The colours sink into the body of the plaster and thoroughly stain it; and as the oil evaporates there is nothing except perhaps a greater depth in the colour to show that one is not looking upon a true fresco. True fresco is apt to dry pale as the water evaporates, and to lose depth of tone thereby. There is always a certain delicate charm and purity of colour about it (shared by Gambier Parry's spirit fresco also) which other sorts of painting do not yield. Further, the known difficulties are so great as to enhance the value of all such works of art. The proverbial dangers of retouching, whereby many a noble picture has been damaged by its creator, do not exist for fresco. The colour once applied cannot be retouched. The whole work therefore glows with the first intention.

FRESNEL, AUGUSTIN JEAN, a distinguished French mathematician and natural philosopher, was born in 1788 at Broglie, near Bernay. His father was an architect. At the age of sixteen years and a half he was admitted a pupil to the École Polytechnique, where he soon made great progress in the study of the sciences, and where he attracted the notice of Legendre by his solution of a problem which had been proposed by that mathematician as a trial of the abilities of the students. On leaving that institution he was appointed engineer successively in the departments of Vendée, Drôme, and Ille-et-Vilaine. In 1823 he was made a member of the Académie des Sciences at Paris; in 1825 he was elected a fellow of the Royal Society of London, and two years later this learned body awarded him the Rumford Medal for his optical discoveries. At the time of his death, which happened in 1827, he held the post of secretary to the Commission for the Lighthouses of France, and he was succeeded in this post by his brother, M. Léon Fresnel. His chief observations resulted in the elucidation of the laws of the action of polarized light and of the diffraction and polarization of light. He also improved the arrangement of the large lenses employed in lighthouses.

FRET, in musical instruments of the stringed kind, is a wire or ridge so placed as to mark the exact part of the finger-board to be pressed for the purpose of producing certain sounds. Frets were formerly much used; but as they entirely annul the valuable power of minute subdivision of tone, or of sliding from one tone to another, they are now never applied to any instruments, except guitars, banjos, and lutes.

FRET, a variety of carving, executed by means of perforations, sawn out with a fine saw, so that the pattern is left in, as it were, a sort of magnified lace work. In most fretwork the surface is even, and the work is entirely sawn; but in the better kinds carving is also introduced to give relief to the patterns sawn out by the fret saws. The saw has to be dismounted after cutting out each "hole," and the holes are started by a bradawl or by a fine centre-bit, or a gimlet. The word comes from the Anglo-Saxon *frætwa*, ornament.

FRET is also a peculiar variety of ornament of a bar-

like design, as it were an iron grating (Lat. *ferrum*, iron; Ital. *ferriata*, a grating). Such an angular interlaced painted ornament was very much beloved by the Greeks, the "Greek key" or Greek fret being to this day a universal favourite.

FRET, in the same sense, is one of the sub-ordinaries in heraldry, as in the badge of the Arundel family, where a cap is surmounted by a fret and an oak spray, the fret being a square with two bars passing through its centre and parallel to its sides. Other heraldic frets are also in bar-like designs.

FREY'A or **FRIG'GA,** the name of one of the principal goddesses in northern mythology, who was worshipped as the goddess of love and pleasure, sunshine, rain, and harvest, by the Saxons, Danes, and other northern nations of Europe. The sixth day of the week was consecrated to her, and still bears her name—Freya day, or Friday. Freya combines the Greek ideas of Aphrodite and Demeter, and was the queen of the Norse Olympus, consort of All-father Odin. She is figured as driving in a car drawn by cats, or at other times by dogs, with whom she pursues the pleasures of the chase. The souls of the heroes who fell in battle were cared for by Freya.

FREY'ER, the brother of FREYA, the queen of heaven in the Norse mythology, was son of Niörder, prince of men, one of the earlier gods or Wanes, whom the Ases succeeded, led by All-father Odin. Freya became Odin's wife; and Freyer also, at the overthrow of the Wanes and the conclusion of peace, was received among the Ases, the new masters of the world. Simrock considers these legends point to an attempt to harmonize the pantheons of diverse tribes. Odin and the Ases were worshipped by the bulk of the Teutonic tribes, Niörder and his son and daughter by others, notably the Suevi. If there were a dim recollection of battle and overthrow of such a separated tribe, this might survive in the fact of the actual overthrow of most of their gods, and their acceptance of the gods of their conquerors with the addition of those they themselves most cherished, the conquerors also agreeing to accept and embody in their faith the chosen gods of the vanquished. Freyer is the Norse Apollo, the sun-god, the god of summer; the myths clustering round his name are all typical either of the sun's strength and gladness of his power over the frost-bound earth (his wife Gerda he delivered from the frost-giant), or of his temporary eclipse in winter. He is sometimes called *Fro*.

FRIAR-BIRD (Tropidorhyncus) is a genus of Passerine birds belonging to the HONEY-EATERS (Meliphagidæ) and exclusively confined to the Australian region. The species of this genus are distinguished by the form of the bill, which is stout and has a remarkable knob at its base; most of them have some part at least of the head bare of feathers. The Common Friar-bird (*Tropidorhyncus corniculatus*) is an exceedingly abundant and well-known bird in New South Wales, where its singular appearance, and no less singular notes, have obtained for it from the colonists a great variety of names—such as friar-bird, monk, and leatherhead from the former; and poor soldier, pimlico, and four o'clock from the latter. The head is covered with a naked black skin. The plumage of the upper surface is grayish-brown; that of the lower surface grayish, except the chin, throat, and chest, which are covered with lanceolate silver-white feathers. The length of the bird is about a foot. The topmost dead branches of lofty trees are usually selected by it for the exhibition of its vocal powers, and by this means it attracts more than an ordinary share of attention. It is very active among the branches, being able to cling in almost any position; its flight also is powerful, and during the breeding season it manifests great boldness and pugnacity, driving all other birds, even hawks and crows, to a distance from its nest. The nest is large and rather wide, cup-shaped, and composed externally of strips of bark and wool, followed by fine twigs, and lined with grasses and fine fibres; the eggs are usually three in number, of a pale salmon colour, with minute darker specks.

Four other species are found in Australia. Other species inhabit the surrounding islands. Mr. Wallace ("Malay Archipelago") notices that two species of friar-birds inhabiting respectively the islands of Bourn and Ceram, are "mimicked" by two species of Oriole of the genus Mimeta, which copied the knob on the bill and the black patch of bare skin round the eyes of the friar-birds. The friar-birds, from their pugnacity, being unmolested by the smaller birds, it would be a distinct advantage for weaker birds to closely resemble them in appearance.

FRIARS (Fr. *frères*, Lat. *fratres*), a term in strictness meaning the brethren of a community, but more particularly applied to a new order of mendicant religious persons who mostly sprang up at the beginning of the thirteenth century, and who were encouraged in the hope of restoring respect for monastic institutions, the munificent endowments of which had led them to degenerate from their primitive austerity and yield to luxury and indulgence.

These friars consisted of Dominicans, Franciscans, Trinitarians or Maturines, Crossed or Crutched Friars, Austin Friars, Friars of the Sac, Bethlehemites, Friars of the Order of St. Anthony of Vienna, Friars de Pica, and Bonhommes or Good Men. These last were brought into England by Edmund, earl of Cornwall, in 1283, and a colony of them was placed at Ashridge in Buckinghamshire. The Capuchins and Observants were varieties of the Franciscan Friars.

Their reputation quickly rose to an amazing height. The pope allowed them to travel freely. Many of them cultivated literature with the greatest assiduity and success, and became the chief ornaments of the universities. The chief orders are treated of under their respective titles.

FRI'BOURG, a canton of the Swiss Confederation, is bounded N. and E. by Berne, S. by Vaud, and W. by Vaud and the Lake of Neuchatel. Its length from north to south is 40 miles; its breadth, which is very unequal, is about 28 miles in the widest part; its area is 632 square miles; and its population in 1880 was 115,400, mostly Roman Catholics.

The south part of the canton is very mountainous, being covered by offsets from the great Alpine chain which divides the waters that fall into the Rhône and the Lake of Geneva from those which flow into the Aar. The drainage, with the exception of a small part carried to the Lake of Geneva, belongs wholly to the Aar, which receives it chiefly by the Saane or Saarine. The Broye traverses the Lake of Morat, and enters Lake Neuchatel.

The climate is cold in winter, and subject to sudden changes of temperature in the spring and autumn. The principal productions of the soil are wheat, rye, barley, and oats; good pasture, both natural and artificial; some vines and other fruit trees, tobacco plantations, and timber or forest trees. In general the canton does not produce sufficient corn for its own consumption. Potatoes are also cultivated. The cheeses made in the canton of Fribourg, especially the Gruyère, are among the best in Switzerland.

The industries, which are not very considerable, consist of straw-plaiting and tanning of leather, and there are distilleries of kirschenwasser, tobacco manufactories, iron-works, glass-works, and paper-mills. Coals are dug at Weibelsried and at Semsale. Turf is cut in the marshes of Morat and elsewhere.

The game consists of hares, chamois, red partridges, woodcocks, wild ducks, &c. Wolves and bears have become very rare, and stags and boars are extinct. The rivers and lakes abound with trout, carp, pike, tench, and eels.

The natives of the canton are generally robust and well

made, especially in the highlands; they are sociable, intelligent, simple in their manners, docile, and inclined to superstition. The Roman Catholic is the predominant religion. Over the greater part of the canton several French or rather Romance dialects are spoken, but the educated people speak good French. In the northern and eastern districts, which approach Berne, a Swiss-German dialect is spoken.

The territory of the canton of Fribourg or Uechtland (meaning "waste land," because formerly an uncultivated district) formed part of Burgundy in the eleventh century; it was afterwards governed as a fief of the empire, and obtained many privileges. In 1450 the Duke Albert of Austria, being unable to give assistance to Fribourg, which was assailed by Berne and the other Swiss cantons, released the citizens from their oath of allegiance, and left them to shift for themselves, after having plundered them of all their silver and plate. Fribourg then remained for some years under the protection of the dukes of Savoy. In the war of Burgundy it took the part of the Swiss against Charles the Bold, in recompense for which it was received into the confederacy as a sovereign canton or state in 1481. In 1818 a liberal constitution was established. Six members are sent from this canton to the national council. The annual revenue, which amounts to about 1,200,000 francs, is chiefly derived from a direct tax on income.

FRIBOURG, the capital of the above canton, is built on several steep hills on both banks of the river Sarine, and its appearance is extremely bold and picturesque. Four bridges join the two banks of the Sarine, one of which, an iron suspension bridge, is one of the finest in the world; its length is 906 feet, and it stands 170 feet above the level of the river. In front of the town-house, in which the great council meets, is an ancient lime tree supported by stone pillars, about which there is a legend that it originated in a twig brought by a young native of Fribourg, who had been sent to announce the victory of Morat in 1476. Breathless and exhausted with loss of blood he had only strength to utter "victory" before expiring. The other remarkable structures in the town are—the collegiate church of St. Nicholas, containing one of the finest toned organs in Europe, and built in the twelfth century; the monastery of the Ursulines; the Lyceum, annexed to which are collections of medals, mineralogy, zoology, &c.; the Chancellery; the convent of the Franciscans; and several other convents and churches. The population is 11,000, most of whom speak French; but as the town lies on the boundary of the two tongues many of the lower orders speak German. The town has manufactures of woollen cloths, straw hats, hardware, porcelain, leather, and sugar. Fribourg is 16 miles S.W. from Berne, and 32 miles N.E. from Lausanne.

The upper town was founded in 1175 by Duke Berthold of Zähringen; the lower town had existed previously. In 1277 Fribourg fell into the possession of Rodolph of Hapsburg, but in 1450 it became a free city of the empire. The Duke of Savoy soon afterwards constituted himself its protector, but the Fribourgers having distinguished themselves in the contest against Charles the Bold of Burgundy, the city and its territory were received into the Swiss Confederation in 1481. In 1476 a celebrated Swiss diet sat within the walls of Fribourg, and in 1803 another, the latter being that at which the French Act of Mediation was accepted.

FRICTION. When one surface in motion comes into prolonged contact with another surface, an amount of resistance is produced which we call *friction*. All substances are distinguished by a greater or lesser amount of roughness, owing to the innumerable small asperities and inequalities which cover them; and the quantity of friction resulting from their rubbing together is regulated by this amount of roughness. When it is very great, the resistance is very great, and *vice versâ*. Friction is, consequently, a retarding or delaying force; it can check or destroy, but it cannot generate motion; it acts powerfully as a mechanical agent, but always with a tendency to promote repose and insure stability. In the useful arts it is, therefore, of importance we should understand its laws, should know how to increase or diminish it when necessary; for if a maximum of friction be useful in the construction of arches, its minimum is just as desirable in machinery, where the great end of the machinist is to remove every obstacle to the full and perfect working of the motive force.

Numerous experiments were unsuccessfully made by Euler, Muschenbroek, and Desaguliers to determine these laws, and very little real progress was made in the matter until Coulomb published, in 1781, the result of a series of investigations which he had undertaken and carried out with peculiar patience and ability. His labours have been supplemented by the exertions of Vince, Wood, Tredgold, Rennie, Morin, Rankine, Tyndall, and others, so that the mechanician is now provided with a perfect storehouse of illustrative facts and inferential data.

First, then, it has been satisfactorily demonstrated that the friction of any two substances increases in proportion to the pressure brought to bear upon them. Thus, if a block be double the weight of another, and both, having equal surfaces of contact, are placed on one plane of uniform nature, the force required to work the first will be double that which is needed to work the second.

Secondly, the friction of any two surfaces increases in proportion to the force with which they are brought in contact, but does not depend upon the extent of those surfaces. Thus, if a block of 60 lbs. weight can only be moved by a force equal to, let us say, 25 lbs., it will require a force of 50 lbs. to move *two* blocks, each of the same weight, placed *side by side*. But place the one block of 60 lbs. upon the top of the other block of 60 lbs., and still an identical amount of force (50 lbs.) is indispensable to move them.

Thirdly, friction is increased by time. Thus it requires the application of a somewhat greater force to move an object from its position of rest than it does to keep it in motion when a momentum has once been obtained. In other words *friction of quiescence* is greater than the resistance to continued motion.

Fourthly, the friction of motion is not in any way connected with the velocity of motion.

These propositions, though of great value in practice, are not applicable in all cases. The amount of friction between two bodies will depend very much on the substances of which these bodies are composed. Thus between oak and cast iron it is about ·38; for wrought iron on wrought iron the amount is represented by ·44; for brass acting upon cast iron (the surfaces being dry and horizontal in all these cases), ·22. This fraction, which expresses the proportion existing between the pressure of two surfaces and their friction, is called the *coefficient of friction*.

In the following table we show the comparative friction of different metals under an average weight or pressure of from 54·26 lbs. to 69·55 lbs.

Name of Metals.	Average Load in Lbs.	Proportion of Load to Friction.
Brass upon wrought iron,	69·55	7·312
Brass upon cast iron,	54·25	6·745
Brass upon steel,	69·55	6·592
Hard brass upon cast iron,	54·25	6·581
Brass upon brass,	69·55	6·764
Steel upon steel,	69·55	6·860
Wrought iron upon wrought iron,	69·55	6·561
Cast iron upon cast iron,	54·25	6·475
Cast iron upon wrought iron,	69·55	6·023
Cast iron upon steel,	69·55	6·393
Tin upon tin,	69·55	3·305

From these data we may infer that the friction between hard metals is inferior to that between soft, and that the friction of hard against hard may, as a general rule, be computed at about one-sixth of the pressure, or ·17.

The following table, founded on Morin's experiments, shows the coefficient of friction of certain plane surfaces after they had been for some short time in contact:—

Name of Surface.	Condition of Surface.	Disposition of the Fibres.	Coefficient of Friction.
Oak upon oak,	Dry.	Parallel.	·60
Oak upon oak,	"	Perpendicular.	·54
Oak upon oak,	Wet.	"	·71
Elm upon oak,	Dry.	Parallel.	·69
Elm upon oak,	"	Perpendicular.	·57
Ash upon oak,	"	Parallel.	·50
Fir upon oak,	"	Perpendicular.	·52
Beech upon oak,	"	Parallel.	·53
Wild pear upon oak,	"	"	·44
Service tree upon oak,	"	"	·57
Wrought iron upon oak,	"	"	·62
Brass upon oak,	"	"	·62
Copper upon oak,	"	"	·74
Hemp cord upon oak,	"	"	·64
Oak upon cast iron,	"	"	·38
Wrought iron upon wrought iron,	"	"	·44
Brass upon cast iron,	"	"	·22

The friction of red teak upon red teak, when the surfaces are pressed together by an amount of force varying from 56 lbs. to 1456 lbs., is such that, on an average, there will be required $\frac{1}{8\cdot82}$ of the pressing weight to move the upper body on the lower. Black beech upon black beech necessitates the application of a force equal to $\frac{1}{7\cdot13}$ of the weight; and Norway oak upon Norway oak, about $\frac{1}{7\cdot07}$.

To diminish the resisting energy of friction grease or unguents are liberally employed.

It is known that when gun-metal is loaded with weights varying from 1 to 2 cwts., the friction varies nearly in the proportion of 1·7 to 1·4 of the pressure, and is scarcely affected by time; that it increases when brass, and diminishes when cast iron is tried; and that the decrease is still greater when black lead is interposed between the three different metals.

But if oil be employed for gun-metal or cast iron, with a weight of 2 cwts., the friction will amount to only $\frac{1}{8\cdot33}$ of the pressure. Diminish the insistent weights, and you reduce the friction to $\frac{1}{37\cdot33}$; cast iron, under similar conditions, showed less friction, which was also diminished by the application of hog's lard.

The coefficient of wrought iron upon dry oak is ·49. Use water, and it sinks down to ·26; dry soap, and it is diminished to ·21. The rule seems to be, that with the unguents hog's lard and olive oil interposed in a continuous stratum between them, surfaces of wood on metal, wood on wood, metal on wood, and metal on metal (when in motion), have all of them very nearly the same coefficient of friction; the value of that coefficient being in all cases included between ·07 and ·08. Tallow gives the same coefficient as oil, except when metals are brought to bear upon metals; it then rises to ·10.

In conclusion, we may state that with all porous substances friction is increased by time and surface, and diminished by time and velocity. With woods, metals, and stone the amount of friction is simply in proportion to the pressure, and is unaffected by time, surface, or velocity.

Friction plays a very important part in every-day life. Coil friction enables us to transmit power by means of belts; rolling friction enables us to travel by locomotives; while sliding friction is always acting. It enables us to stop ourselves when walking or running by taking advantage of the friction between the soles of our boots and the ground; it is applied in the "brakes" used for stopping railway trains and machinery; and may, indeed, be said to keep everything in its place. If, for example, there were no friction, every breeze of wind would set in motion loose stones, wood, &c.

FRIENDLY ISLANDS, or **TONGA ISLANDS** (named "Friendly" by Captain Cook), were discovered by Tasman in 1643, are situated in the Pacific, between 18° and 23° S. lat., and 173° and 176° W. lon. They consist of three separate groups, which are said to contain more than 150 islands. They are usually low and surrounded by dangerous coral reefs. The largest of the most southern group, Tonga, is about 20 miles long and 12 miles wide in the broadest part. It rises about 80 feet above the sea, and its summit is a level plain. On the northern side an excellent roadstead was discovered by Cook. The central group, called the Hapai Islands, is composed of a considerable number of small islands. The largest of them is Lefooga, about 8 or 9 miles long, and 4 wide. The most northern group is formed by the Vavaoo Islands, which are likewise small and low, except the island of Vavaoo, which is about 36 miles in circumference. On its southern side is Curtis Sound, or Puerto do Refugio, one of the most spacious and safest harbours in the Pacific. These islands are remarkable for the mildness of their climate, their fertility, and the great variety of their vegetable productions. For food there are cultivated cocoanut trees, bread-fruit trees, bananas, yams, sugar-cane, and sago; the Chinese paper-mulberry tree is cultivated for its inner bark, from which the clothing of the inhabitants is made. Hogs and dogs are numerous, and both are used for food.

Cook called these islands the Friendly Islands, because he was received by the inhabitants in a very friendly manner; but it is now well known that they intended to kill him and to seize his vessels. They are a very industrious people, and pay great attention to the cultivation of the soil, and they apply themselves also to fishing. They belong to the Malayan race. The population is estimated to amount to about 25,000.

Lakemba, the largest island in the east, is the headquarters of the Wesleyan missionaries, whose zeal has done wonders for the civilization and conversion to Christianity of the natives. Other denominations have also important missionary stations in the islands.

FRIENDLY SOCIETIES. Friendly or benefit societies may be regarded as associations of persons, generally belonging to the working classes, for the purpose of preserving each other from destitution during sickness, and insuring the payment of a certain sum to relatives on their decease. By these means the families of such workmen as do not enjoy an average degree of health are made sharers in the better fortune of those who do. The irregularities of life and health are thus, in some measure, compensated, while the social independence of the sufferers is preserved until they are restored to their usual healthy working condition. The manner in which this is accomplished is very simple. Each member contributes to a common fund at the rate of so much per week, and out of this fund the stipulated allowances are paid. It will be obvious that such institutions, however faulty they may be in detail, cannot fail to exercise a most beneficial influence upon society at large; and the fact that 4,000,000 working men, representing an aggregate of about 10,000,000 of the population of the United Kingdom, should have spontaneously organized themselves into voluntary associations for mutual support in times of sickness and distress, is one which says a great deal for the feeling of manly independence cherished by the poorer classes of the country. In France only one person in seventy is found

belonging to a benefit society, in Belgium only one in sixty, while in England the proportion is as high as one in six. In fact, there is no doubt that there are more friendly societies for mutual relief in sickness, &c., in Great Britain than in the whole of the rest of Europe or elsewhere; and the sum-total of their funds amounts to nearly £12,000,000 sterling.

In order to secure the benefits sought by a working man in joining these societies, it is necessary that men should combine together in sufficient numbers to secure the average results, and that the affairs of the societies should be administered according to a sound system of rules. The earliest attempts at such combinations, viz. local village clubs, failed in all these requirements. They attempted to combine conviviality with business to an excessive degree, and not only relied upon eating and drinking and the annual feast as their grand advertisement, but they were constantly promoted by rival publicans to attract custom to their houses. Founded originally with insufficient rates, they struggled until their members grew old, or until the rivalry of the newly-started clubs attracted the younger men, and compelled the older club to enter into competition for new members, and by lowering their rates or increasing their benefits to keep themselves alive for a few years longer. Then at length came the crash; the younger men joined new clubs, but the older were left to rely upon their virtual superannuation fund—the poor rate, which it had been from the first their object to avoid. In 1881 there were over 4000 paupers in England who had been members of Friendly Societies which had failed, and more than 1000 of them had contributed for fully twenty years.

This is the inevitable fate of village rival clubs, in which the tendency generally is to rely too much upon honorary subscriptions. They are started, perhaps, by an energetic clergyman, who persuades the neighbouring squires and farmers to give a handsome contribution. As years go on their successors cease to feel an interest in the club, or (seeing, perhaps, it is badly managed) withdraw their assistance. The club struggles on for a short time longer, and then breaks up.

Nothing is more clear than that a local club ought to be self-supporting as regards all the benefit which it promises, and a sound village club on this principle is so rare that it may be almost pronounced an impossibility. It would seem, therefore, that the only way to obtain financial security, especially in the case of payment for old age or at death, is to be found in an extension of area, and several agencies with this object in view have of late years been at work in this country.

The first is that of the patronized societies. County friendly societies have been established mainly by the principal landowners and clergy, the most flourishing being those of Essex, Wiltshire, Hampshire, Dorset, and Kent. In country districts it was found extremely difficult to obtain really competent persons from the members of these societies who could give the necessary time to their management, and they are therefore managed by a central executive of honorary members who derive no benefit from the funds. The total number of these societies is small, including only about 40,000 members, with a tendency to diminish, probably partly owing to the increased hold which combination under their own management has gained upon the labourers.

Another class of societies maintained by patronage consists of those among railway servants, miners, and colliers. In some cases membership is made compulsory, and contributions are deducted from their weekly wages, a liberal subsidy being in return contributed by the employers. In these societies it is to be observed that compulsory membership, and the making of membership to cease or be less beneficial if and when the employment ceases, necessitates great dependence of the employed upon the employer. Where, however, the members have a voice in the management of the funds, and where on dismissal the equivalent of the member's purchased interest is returned to him, these societies are among the best and safest by which a workman can provide for sickness, old age, or life insurance.

The second and most important of the agencies to which we have alluded as exercising of recent years an important influence over the old local clubs, is that of the affiliated orders. Of these the two largest and best known are the Manchester Unity of Oddfellows and the Ancient Order of Foresters. Each fully developed order consists, first, of the primary branches or "lodges;" then of the "districts," comprising groups of branches associated together in order to secure a larger area for certain forms of insurance; and lastly, of the central executive, composed of delegates from the various branches, who deliberate together after the manner of a periodical parliament. The chief cause of the success of these societies is the popularity of their management. Local interest is stimulated, and many men prefer entering a society of which they may not unreasonably look forward to becoming the responsible managers. This love of office is found, however, to have a tendency to the undue multiplication of orders. The founder of a new order is a man of mark, and if he is able to announce his adherence to some popular rule or custom which the original order is endeavouring to reform, he is almost assured of success. It is in this way that many wholesome reforms of the Manchester Unity have from time to time led to large secessions from that order. There are thus several other orders of Oddfellows besides the Manchester Unity. The members belong chiefly to the class of artisans and small tradesmen, and a very small proportion of labourers in rural districts.

The last class of societies necessary to be noticed are the burial societies, either *local* or *general*, the latter being in reality only a species of insurance offices conducted, in too many instances, principally for the benefit of their promoters, and quite incidentally for that of the assured.

The local burial societies had their origin in the desire existing among working men, on the decease of one of their fellows, to collect a small sum for his funeral and for his widow. They seldom retain in hand more than a few shillings per member, but rely upon what was the original principle of such societies, the power of levying a certain sum per head to meet the necessary claims. These local societies ought to be, and very often are, cheaply managed, but when they employ collectors they to some extent exhibit the same abuses as the larger class, or "general" burial societies.

The statement of Mr. Tidd Pratt, the registrar of friendly societies, that out of 23,000 societies in England and Wales not twenty were solvent, caused the appointment in 1872 of a royal commission of inquiry on friendly and benefit societies of all kinds. Their report was published in 1874, and while satisfactory so far as showing the strong desire even of the poorest and most ignorant classes to try to exercise some degree of thrift and foresight, it at the same time revealed a melancholy picture of the extent to which these classes were deluded and plundered, and it was seen that an alteration of the law was necessary.

The legislature, indeed, might well feel anxious to alter the law, inasmuch as the then existing Act of 18 & 19 Vict. c. 63, which governed friendly societies, was responsible for no small amount of the mischief connected with them. By that Act a registrar of friendly societies was appointed, who was to be a competent barrister. To him the rules of such societies might be submitted, and if they complied with certain technical points of law, he granted a certificate to that effect. This certificate was little more than a statement that the object of the society was not a seditious one so far as the state was concerned; but in advertising a society its promoters now pointed to the symbolic coat of arms, and paraded the fact of the rules having been certified by a "government official." In the eyes of

hundreds of thousands of simple unsuspecting people, such a certificate was an unquestionable guarantee of financial soundness, able and economical management, and absolute security; while, as a matter of fact, the registrar was *bound*, on certain forms being complied with, to give his certificate, although he might know that the rules he signed insured rapid insolvency and ruin. Moreover, he might see clearly that the rules were so framed as to enable a few designing people to get hold of the management, to get the largest amount of plunder out of them for themselves and their relatives, and retain the control in spite of the members, and yet the registrar would have no power to interfere in the interest of the class who most needed the protection of government. Patent medicines are sometimes said to command the faith of even educated people because of the government stamp; and the misleading regulation of a government certificate, provided by the Act of 1855, enabled thousands of hollow friendly societies to gather millions of credulous victims within their toils, all of whom, on seeing the royal coat of arms attached to the rules of their club, took it for granted that a paternal government was watching over their interests, and that they might go on paying their subscriptions with an easy mind.

The investigations of the royal commission proved beyond a doubt that very few indeed of the 32,000 friendly societies in the country were really solvent. The soundness or unsoundness of a benefit club is not a matter of opinion; it is a question of fact. Given the scale of premiums, the conditions of membership, and the advantages offered, and an actuary can ascertain at once whether it is possible that it can pay its way. When this test was applied to the Manchester Unity of Oddfellows, which is not only the largest, but one of the best organizations of its kind, it was found to have a deficiency of more than £1,300,000. The cause was clear. The order allowed its lodges to fix their own rates of payments, and in very many cases these had been fixed at haphazard, much too low for the benefits promised, and had been kept low to compete with other societies. Some of the affiliated orders enforced one rate of subscription throughout their lodges; but this had proved insufficient, and in spite of really excellent management they shared the almost general verdict of insolvency.

It should be explained, however, that generally speaking this insolvency was actuarial and not commercial, and the two are widely different. Commercial insolvency for a friendly society really begins only when it can no longer pay its claims, and the "box" has to be closed. But it is insolvent actuarially from the moment when the value, calculated according to certain principles, of its existing funds and *future* contributions is less than that of the present and future claims upon it. In other words, supposing all existing members of such a society to pay down at once all that they are ever likely to pay into it, and all existing members and other claimants to claim at once all that they are ever likely to claim from it, if the total claims exceeded the total receipts, together with what may be in hand, there would not then be wherewithal to pay.

Notwithstanding, therefore, that in burial societies and in clubs promoted chiefly by publicans, a vast amount of rascality was found to exist, the insolvency from which the great majority suffered was a curable evil. Again, whatever might have been the motive for their being induced to do so, the fact remains that by means of the friendly societies an enormous number of people have adopted thrifty and provident habits; and the societies, however unsuccessful, represent a leading aspect of the struggle against pauperism of the classes which are most nearly exposed to it. In any measures, therefore, which Parliament might pass to remedy the mischief arising out of the Act of 1855, it was natural that friendly societies should be regarded with respect and sympathy.

By the Friendly Societies Act of 1875 (38 & 39 Vict. c. 60) a chief registrar of friendly societies for the United Kingdom was appointed, with assistant registrars for Scotland and Ireland. His duty is to prepare and circulate for the use of the societies model forms of accounts, balance-sheets, and valuations; also statistics of life and sickness, gathered from the returns under this and other Acts, and officially compiled tables of contributions. These tables are not compulsory, but from them a society may easily see whether it is proceeding on a sound basis or not. A general meeting of the members of every registered society must be held once a year, at which no collector may vote, nor can collectors be members of a society's managing committee. Balance-sheets must be prepared, and the accounts must be audited every year; while the assets and liabilities must be submitted to valuation every five years. No doubt there is a philanthropic idea of some kind connected with many friendly societies, but this is not all. To a very great extent friendly societies are business concerns, and should be conducted on strictly business principles, and the first thing necessary to good business principles is a strict system of accounts and audit. The provision with respect to quinquennial valuation may, however, be regarded as the most important of the Act. As we have just said, there is a distinct business element in every friendly society, and as periodical stocktaking is an indispensable feature in every kind of business, the legislature very wisely insisted upon friendly societies making it their duty periodically to ascertain their exact financial position. The making of a friendly society's valuation is, however, when properly done, a matter requiring very considerable actuarial skill, and if such an important matter were left to be done by any person who could induce societies to employ him, it is not at all certain that more harm than good would not arise. Accordingly the Act provides for the appointment of public valuers, to make valuations for whatever societies may seek to avail themselves of their services at a fixed scale of fees. The weakest part of the Act is that both annual audit and quinquennial valuation may be done by members of the society. Deception therefore is still possible, if designing managers of any society like to secure the complicity of a couple of members. Even should no fraud be intended, the balance-sheet and general account may yet show that a society is proceeding on a wrong basis, and one that inevitably leads to utter insolvency; but although the registrar may see this, he cannot withhold his certificate if technical legal requirements be complied with. Both annual accounts and valuation report are to be transmitted to the registrar, and copies furnished gratuitously to members on application. No society may grant annuities or superannuations unless its tables are certified by a competent actuary. Lapses are guarded against as far as possible by making due notice compulsory before forfeiture of payments takes place. The registrar may direct a special examination into the affairs of any society on application of a certain proportion of its members; and has power, under certain circumstances, to suspend or cancel societies. Registered societies enjoy the benefits of a recognized legal standing, may sue and be sued, are exempt to some extent from the stamp duty, and may invest their funds with the National Debt Commissioners or the Post Office Savings Banks. The Act of 1875 comprised several new and excellent regulations, and there appears a general disposition on the part of friendly society managers to conform fairly to its spirit.

Another weak point is that societies can be enrolled under the Companies Act instead of under the Friendly Societies Act, and thus evade various laws. These industrial assurance *companies*, being competitors with *societies*, should be submitted to the same supervision. At present they are practically free to do as they please, and as a consequence spend in management sums which, in certain cases at least,

are indefensible. Were they required to give policy-holders a detailed balance-sheet annually, and to have their assets and liabilities valued by a public valuer every five years, contributors and the public generally would know how the money collected was disposed of, and what societies were solvent. Friendly societies are required to furnish policy-holders annually with a balance-sheet detailing income and expenditure, while industrial insurance companies are not. A periodical valuation of societies and companies, conducted on uniform principles, would be of immense benefit to members. At present one valuer gives credit for one percentage of prospective lapsing, and another for a different one. As the law stands companies may also practically bring about a dissolution whenever they please, and that without the consent or knowledge of the insured. Societies, on the other hand, cannot be dissolved except by the members and by consent of the registrar. Persons who insure with these companies are only policy-holders, and have no right or interest in the funds or control of the management.

No doubt there is vastly more to be done yet before the bulk of our working population can be trained either to make such provision as they might for their own necessities, or to make that provision wisely. But the law can neither force them to make the provision, nor impart the wisdom which should make it succeed. The law may do something, science may do something, counsel, from those who know how to give it, may do something; but the main source of success must be in the growth of their own intelligence, honesty, and mutual faithfulness. Nor must it ever be forgotten that self-government implies at all times the possibility of self-misgovernment, and that for a people sturdy, self-reliant, and doggedly resolute like the British, the most fruitful of all teachings are those of their own blunders and failures. In France registered friendly societies possess the very great advantage of being provided with offices rent free in which to carry on their business. It is the commune that is charged with this burden, and in case of inability to support the cost the duty is transferred to the department. See also Annuities, Post Office.

FRIENDS, SOCIETY OF, the proper designation of the sect of Christians who are more generally termed *Quakers*. The latter title is said to have been bestowed upon them, in the first instance, by a persecuting justice, who was admonished by the founder of the sect to tremble or "quake" at the word of the Lord.

Origin.—The founder of this society was George Fox, who was born at Drayton in Leicestershire in 1624. At first employed in tending sheep, he was afterwards apprenticed to a country shoemaker, with whom he worked until he reached the age of nineteen. At this period his religious impressions were of such a character that he resolved to abandon his trade and to give himself up to prayer and meditation until he found an answer to the spiritual problems that perplexed him. He accordingly made for himself a suit of leather, and trusting to Providence for the means of support he commenced a series of long wanderings about the country, with the result that after much spiritual conflict and inquiry into the merits of the different sects that had arisen in England, he separated himself from all, feeling that "none could speak to his condition." By degrees his religious opinions assumed a distinct form, and in the year 1647, when he was twenty-three years of age, he commenced the work of a religious reformer by preaching at Dukinfield, near Manchester. He afterwards journeyed through most of the midland counties, his preaching everywhere causing great excitement and gaining for him many converts, until in 1655 he was brought to London and examined before Cromwell. After hearing his defence Cromwell pronounced in his favour, but notwithstanding this he was afterwards subjected to much persecution and frequently imprisoned. The same treatment was allotted to his followers, but at his death, which took place at London, 13th January, 1691, the society founded by him had become firmly established both in England and America, and numbered among its members not only the poor and uninstructed, but also many from among the opulent and educated classes.

Tenets.—The principal points on which the teachings of Fox differed from the prevailing forms of Christianity were his rejection of the authority both of the church and the letter of the Scriptures in favour of a reliance upon the indwelling and ever-present Holy Spirit; his disregard of the sacraments, of the use of all prescribed forms of prayer, and of any *order* of ministry. The central point of his teaching was his fuller recognition of the universality of the teaching of the Holy Spirit, whose presence in man gives rise to an inner light for spiritual discernment, and most of the details of his system are the logical results of this principle.

At the same time Fox accepted most of the great fundamental doctrines of Christianity, and in a letter addressed to the governor of Barbadoes, in 1673, he asserted most of the beliefs contained in the Apostles' Creed, laying, however, especial stress upon the inner spiritual work of Christ.

The Society of Friends have never drawn up any series of articles or creed subscription to which is required of their members, but their principal tenets may be gathered from the writings of the founder of the society, of Robert Barclay, William Penn, and others, and also from the minutes and epistles issued by the yearly meetings in London to the subordinate meetings elsewhere. There is also a publication entitled the "Book of Christian Discipline of the Society of Friends," which is now issued in London, and which may be regarded almost as an official exposition of their doctrines. From these sources it may be gathered that the Friends believe that the light of the spirit of Christ does in measure enlighten every man that cometh into the world; that the effects of the death of Christ are coextensive with those of Adam's transgression, according to the declaration of the apostle, "As in Adam all die, even so in Christ shall all be made alive;" and as a consequence thereof, that even those who have not the outward knowledge of the gospel history may, by giving heed to their measure of this light, become partakers of that salvation which comes by Jesus Christ.

At the same time it must be observed that some eminent members of the society have rejected the orthodox doctrines of the Trinity and the atonement, or at least have interpreted these doctrines after a manner peculiar to themselves. Thus William Penn and George Whitehead in 1668 endeavoured to maintain in a public discussion that the doctrine of three persons in the unity of the Godhead is not found in Scripture, and one of the publications of Penn is directed against the doctrines of the vicarious atonement and the imputed righteousness of Christ. At a later period, about the year 1827, the American society was rent in two by a controversy excited by the teaching of Elias Hicks, who maintained what may be briefly described as Unitarian views concerning the nature of Christ, and rationalistic ideas concerning the nature of the sacred Scriptures. About half of the American body accepted the teaching of Hicks, and are in consequence known as the Hicksite Friends, but the remainder and the members of the English society were led by this controversy to assert more strongly than ever their evangelical principles.

The Friends generally hold it to be the prerogative of Christ to call and qualify by the Holy Spirit those whom he commissions to declare unto others the way of salvation, or to edify and instruct believers in the faith; hence they appoint no *order* of ministers, and have no theological colleges

or training schools for their teachers. They consider the instruction and edification of their congregations to be the province of any person of either sex who feels himself or herself moved by the Holy Spirit to this service. As such have freely received the gift of the ministry, so are they freely to give without hire or bargaining, far less to use it as a trade to get money by. Hence they refuse the payment of tithes and all ecclesiastical imposts, though they readily support such of their own number whose special gifts in the way of teaching have led them to devote themselves wholly to this work. Believing that the true worship of God is offered in the inward and immediate moving and drawing of the Holy Spirit, they abstain from the use of all prescribed forms of prayer, and when they meet they remain in silence until this influence is felt. They do not practise either baptism or the rite of the Lord's Supper, and they disregard all ecclesiastical fasts and festivals, though many regard the observance of the Sabbath as being obligatory.

Friends deem the taking of all oaths unlawful, and are specially privileged to make affirmation instead on entering Parliament, and also, in common with others, to affirm instead of swearing in courts of justice. They believe, too, that all wars and fighting are inconsistent with pure Christianity, hence they have ever refused to bear arms or to assist in military affairs. They were also steadfastly opposed to human slavery, and their efforts towards its suppression form an important portion of British and American history. They believe marriage to be a divine ordinance, but in their marriages they do not use the intervention of a minister, for which they allege there is no scriptural warrant. The Friends have also observed from the earliest times a remarkable plainness and simplicity in their dress, and for a considerable period may be said almost to have worn a special uniform or distinctive costume. At the commencement of the present century, and for many years afterwards, a Friend was expected to wear a suit of a drab colour, the coat being collarless and destitute of buttons behind, and the hat distinguished by a brim of peculiar breadth. They have also ever been distinguished by a great sobriety of manner, a disregard of conventional terms of respect and distinctions of rank, and by the use of certain peculiarities of speech too well known to need enumeration. Another and most important feature in the history of the Friends is the abundant charity they have ever displayed towards the poor. They do not insist upon the observance of any specified rule as to the proportion of income, &c., that should be devoted to this work, but from the earliest times they have regarded the support of their poorer members as a duty enjoined by Christian love, while their liberality towards others, and their support of reformatory and philanthropic work, has been of the most praiseworthy character.

Organization.—In England the affairs of the society are conducted by means of a series of meetings, known as the preparative, monthly, quarterly, and yearly meetings. The first of these is usually made up of the Friends of any given town and district, and such meetings take note of the births, deaths, removals, &c., of the members, and report upon any case that calls for discipline to the monthly meeting. The latter is usually a gathering of a larger number of members, and its proceedings are of a more important and varied character. The monthly meeting has the power of expelling any unworthy member from the society, but the person thus expelled has the right of appeal to the next quarterly meeting, and from that to the yearly meeting, the decision of the latter being final. The quarterly meeting is made up of a number of monthly meetings, and the yearly meeting takes under its cognizance the whole state of the society. The yearly meeting is usually held in London after the third Sunday in May, and its sittings extend over several days. It receives reports of the state of the particular churches, and issues to them a general letter.

Of recent years not only have what were considered the peculiarities of the body to a great extent vanished, but with the disuse of singularity in modes of speech and dress there has been a reform in much of the machinery, a change in the polity, and there is some tendency to alteration even in the doctrinal views of the Friends. There is a greater tolerance of practices against which the early Friends testified, as, for example, the payment of ministers, and a greater disinclination to urge their special views on these and kindred points. Church rates having gone, the ground for testimony against such payments has been cut from beneath their feet, and it is now not unfrequent for wealthy Friends to afford pecuniary help to church building. At revival missions, whether held by church or dissent, some of the ministers of the society occasionally take part, and many of the more zealous Friends have organized mission meetings and Firstday or Sunday school teaching agencies, in which Christian work the younger members of the body have largely engaged. The usual Friends' meeting proceedings, so frequently silent, would for these outside audiences be clearly unsuitable; and there is consequently a sort of compromise between the mode of worship in the usual gatherings of the body and those of other dissenters. There is frequent reading of the Bible, and even singing; and as regards the first of these practices, the mission meetings have certainly paved the way for its introduction in the ordinary meeting-houses. In a measure, even the theological belief of Friends has been drawn by these influences in the direction of evangelicalism; and many of the addresses given in their meetings are now scarcely distinguishable, except in their shortness and surroundings, from the sermons of dissenting ministers. It is clear, therefore, that the original peculiarities of doctrine are held much more loosely than formerly; but the society still tenaciously maintains its ancient protest against war, slavery, and intemperance, and its influence is all the more powerful because of the unquestionable sincerity of the belief of its members, and the conformity of their practice in the battle against these evils.

The effect of the alterations we have indicated is a tendency to increase in the numbers of the Society of Friends, an increase wholly from without, and largely from the working classes, attracted to it by its adult schools, its mission meetings, and other causes. The numbers thus added are chiefly sources of strength numerically. As a rule they have little appreciation of those principles which have given to Quakerism its strength, its influence among other religious bodies, and its still stronger influence on the world. On the other hand, they remove from it the reproach of being a close and wealthy corporation; they to a certain extent popularize it, and certainly furnish it with a wider and nearer field of usefulness.

According to recent statistics, it appears that the total number of members in England is about 15,000, and there are at least 6000 or 7000 persons who are regular attendants at the meetings though not members of the society, without including those attending the mission services held from time to time. The numbers in the United States are much larger, reaching nearly 100,000. It is supposed that at the death of Fox the society numbered about 80,000 members in England, so that it has decreased to a very great extent. The society, however, has never relied for its strength upon the number of its members, and when it is remembered that it has never included more than about 200,000 adherents, it will be seen that the influence it has exerted upon the church and the world has arisen from quite other causes. Many things which were contended for by the founders of the organization are now accomplished facts, and though the changed habits and manners of society cannot be wholly attributed to its teachings, no one can deny that its influence has always been pure and elevating, while the work it has

done for the abolition of slavery, the reform of prison management, and in favour of religious equality, is marked so deeply in the history of the world that it can never be forgotten.

FRIES'LAND or **VRIES'LAND,** also called *West Friesland*, the most northerly province of the kingdom of Holland, is bounded N. by the North Sea, E. by Groningen and Drenthe, S. and S.E. by Oberyssel, and W. and S.W. by the North Sea and Zuyder Zee. The area is about 1260 square miles, and the population in 1880 was 329,877. The surface, as well as the soil itself, are so identified in character with those of the province of North Holland, that there cannot be a doubt that they formed one and the same country antecedently to the convulsion out of which the Zuyder Zee, which now separates them, arose. Friesland has no river of any note, excepting the Lauwers, which falls into the gulf of that name. The other streams, the Baare, Linde, Paassens, &c., are broad rivulets of inconsiderable lengths. There are a multitude of small lakes, called *meeren;* and there is a large canal from Harlingen to Groningen. The principal occupation of the people is breeding cattle, growing corn, fishing, and digging and preparing turf for feul. The agricultural produce is more than adequate to its consumption, and some corn is exported. The chief articles of growth are wheat, rye of superior quality, remarkably fine pease, potatoes, buckwheat, and clover seed, which last is exported largely. There are few manufactures; they include woollen stuffs, linens, sail-cloth, salt, paper, and tiles. Shipbuilding is also carried on.

The inhabitants are principally Calvinists. Their language has a greater similarity to the German than to the Dutch: in this respect, indeed, as well as in their dress and manners, they have retained much that was common to their ancestors, the Frisians. In the larger towns Dutch is spoken. The chief town is LEEUWARDEN.

FRIG'ATE was formerly used to describe a vessel of war of a class smaller than line-of-battle ships, and built with a view to speed and easy and rapid management.

FRIGATE-BIRD (Tachypetes or Fregata), a genus of sea-birds belonging to the order ANSERES, nearly allied to the Pelicans (Pelecanidæ), from which family it has recently been separated on account of some anatomical peculiarities; it is now made the type of a distinct family, Tachypetidæ or Fregatidæ. The frigate-birds are distinguished by their long and forked tails, and the great length and power of their wings. Their legs are short, feet small, with deeply notched webs, and their bill has both mandibles curved downward at the tip. The Great Frigate-bird (*Tachypetes aquilus*), or man-of-war bird, as it is sometimes called, is abundant on the Atlantic shores of both America and Africa, and is found throughout the tropics. It passes nearly its whole life in the air, through which it darts with incredible swiftness, or sails along with outstretched pinions at a considerable height, looking out for its prey, on which it descends with lightning-like rapidity and the most unerring precision. Flying fishes and fishes that live near the surface are its prey. Not content with the produce of its own fishing, however, it often acts the part of a pirate, attacking other marine birds, especially boobies and gannets, and compelling them to disgorge their booty. The frigate-bird builds its nest in companies in tall trees. It is about the size of the common kite, but the spread of its wings equals that of a swan. The plumage of the upper surface is of a very dark brown colour. A smaller species (*Tachypetes minor*) is known, agreeing with the great frigate-bird in habits, but with a more confined range. The great frigate-bird will be found represented in ANSERES, Plate I.

FRIG'GA, in Norse mythology. See FREYA.

FRILLED LIZARD (Chlamydosaurus) is a genus of the order LACERTILIA, founded upon a specimen which was brought home by Captain Philip Parker King, R.N., on his return from his survey of the intertropical and western coasts of Australia, performed between the years 1818 and 1822. One species only is known, *Chlamydosaurus Kingii.* It is remarkable for an expanse of skin in the form of two large discs, forming an ample frill to the sides of the neck and throat. The edge of this frill is serrated, and the whole is covered by small keeled scales. There are pores on the thighs. The head is broad and somewhat pyramidal; the tail is very long and tapering. This lizard is arboreal in its habits. It measures about 24 inches from the tip of the nose to the point of the tail. Its general colour is yellowish-brown, variegated with black. The frill appears to be used as a covering and means of defence for its body. According to Sir George Grey, when not provoked or disturbed it moves quietly about, with its frill lying back in plaits upon its body; but it is very irascible, and directly it is frightened elevates the frill and makes for a tree, where, if overtaken, it will boldly defend itself, or even assume the offensive.

FRINGIL'LIDÆ, a family of birds belonging to the order PASSERES. The limits of this family are somewhat uncertain. By some authors it is made coextensive with the division CONIROSTRES, including all passerine birds, presenting a decidedly conical form of bill. As now generally restricted it includes the birds popularly known as finches.

In the family Fringillidæ the bill is generally short and stout, but tapering to a point; the lower mandible has very powerful cutting edges. This form of bill is clearly adapted for the consumption of seeds, which form the principal food of these birds. In the CROSSBILL (Loxia)

Common Crossbill (*Loxia curvirostris*).

the mandibles are remarkably curved, crossing one another obliquely. The feet are slender, the toes are moderately developed and terminated with rather slender curved claws. The species of this family are small birds, and exhibit much agility both in hopping upon the ground or among the branches of trees and in flight. They do not differ greatly among themselves in their habits. Most are remarkable for their skill in building nests. Many are exquisite songsters, and during the spring make our groves and hedgerows resound with their melody. The Fringillidæ are very widely distributed throughout the northern and temperate parts of the world. The following well-known birds are included in this family:—Bullfinch, crossbill, hawfinch, greenfinch, sparrow, chaffinch, bramble finch, goldfinch, canary, aberdevine (or siskin), linnet, red-poll, grossbeak, which will be noticed under their respective headings. The buntings are now usually separated from this family.

FRIS'IANS, a people of Germany, who formed part of the nation of the Ingævones. They were divided into Frisii Minores, who inhabited the lands north of the island of the Batavi—the present provinces of Oberyssel, Gelders, and Utrecht—and the greater part of the province of

Holland, inclusive of the Zuyder Zee, which at that time was mostly dry land; and the Frisii Majores, who inhabited the land between the Yssel, Ems, and the country of the Bructeri—that is, the present provinces of West Friesland and Groningen. From the first until the fourth and fifth centuries, when they appear as members of the great confederacy of the Saxons, no mention of them occurs. We find them at this time holding the sea-coasts from the Scheldt to the Elbe and Eider, whence it has been conjectured that a variety of tribes were then comprehended under the name of Frisians. Many of them then passed over into Britain, in company with the Angles and Saxons. In 1815 East Friesland was ceded by Prussia to Hanover. West Friesland is a province of the kingdom of Holland.

These Frisians were largely mixed with the people whom many call Saxons, but who called themselves *Englisc*—in fact, our ancestors when they lived in Germany, and as yet had no thought of conquering Britain. Many traces of them are found in our language and our customs. One of the most curious of the latter is the extraordinary custom of Borough English, where, as explained in the article on that subject, the property of a man descends by right to his *youngest* (not to his eldest) son. This existed in the "Theel lands," among the Frieslanders of the mouth of the Ems, down even to the present century. The "Theel boers" held their allotments of land under various conditions of indivisibility, and one condition was that they should descend intact to the youngest son, or failing him, revert to the community. It is increasingly believed that from this source the kindred English custom is derived. "Borough English," it is observable, prevails (or prevailed) only in the coast-counties, where Frisian settlers would be likely to come following in the wake of the English invasion. But though considerable tracts, as at Holderness and in the southern parts of Scotland, are clearly shown to have been colonized by Frisians, the number of these people bore no relation to those of the Saxons, Angles, and Jutes. They themselves claim otherwise, and in their legends Hengist (that is, *Hengst*, the Stallion, a *nom de guerre* such as the Indians adopt to this day), the conqueror of Kent, figures as the father of their kings and the builder of their strongholds on the Rhine. In the ancient fragmentary poem of "The Fight at Finnesburg," however, Hengist leads a band of Jutish pirates to fire the palace of the Frisian king. This seems by far more probable, and the other was a later legend invented in order to grasp a share in the famous conquest of Britain. (Elton's "Origins of English History," London, 1882.)

The Frisian language is more closely allied to English than any of the other Low German tongues (of which both English and Frisian are members). The literature of Old Frisian is preserved in documents of the twelfth and thirteenth centuries. The Asega, a code of Frisian laws, bears date about 1200. Its descendant, Modern Frisian, is spoken in Friesland, along the coasts and islands of the North Sea, between the Weser and the Elbe, and in Holstein and Schleswig, the homes of the ancient *Englisc*.

FRITH or **FIRTH**, a term used in Scotland to signify an inlet of the sea or an estuary. The term *loch* is more commonly used on the western coast. It corresponds to the Latin *fretum* and to the *fiord* of the Danes and Norwegians.

FRITHBORH. See Frank-pledge.

FRITHGILDS were one of the early English gilds (or guilds), all of which involved an oath of fidelity and a sense of mutual responsibility. There were frithgilds, merchant-gilds, craftgilds, &c. The first-named of these were for purposes of mutual protection from thieves and murderers. If a member were slain, the gild and not his relatives inherited the wergild or death-fine. This and other curious provisos are found in a celebrated code of a London frithgild of the early date of Athelstan. The institution of the frithgild is a significant commentary on the lawlessness of the times.

FRITH'JOFF'S SAGA, an Icelandic poem of great antiquity. Frithjoff means *peace destroyer*. The hero woos Ingeborg, princess of Norway, and is favoured by her. The poem recounts the obstacles which her unfriendly brothers, including even the marriage of the princess to the old King Hring, threw in the way of the union of the lovers. The adventures are of the eighth century, but the Saga in the form in which we now have it is certainly not older, and it may be later, than the thirteenth century. Tegner's "Frithjoff's Saga" (Stockholm, 1825) is a modern paraphrase in Swedish of the ancient original. It is at once the most favourite and the best of modern Swedish poems, and has several times been translated into the English language.

FRIT'IGERN, General of the Visigoths, organized the great expedition into the Eastern Empire when the Huns drove the Visigoths from their original seat. The Visigoths he led numbered about 200,000 warriors. The Emperor Valens accepted their proffered obedience, but on the condition that they gave up their children, who were sent to distant provinces. He also sought to deprive them of their weapons, but this was evaded, A.D. 376. The emperor disregarding his promises, the Visigoths feared for their safety and rebelled. Fritigern fought the battle of Marcianopolis, which made him master of the northern provinces of the empire, or what we now call Roumania. He then advanced to Adrianople, and there on 9th August, 378, thoroughly defeated and practically annihilated the whole force of the empire. At least 40,000 fell. The emperor himself escaped, wounded, to a cottage, but this was set on fire and he perished in the flames. Fritigern led his Visigoths to Constantinople itself, but was afraid to attack it. Hence he conducted them to the mountains and plains of Thrace, and here they spread out securely, their extreme possessions resting upon Italy and the Adriatic. But the sagacious Fritigern, who had so ably conducted this dangerous exodus to a successful close, died, and in less than four years (382) after the Emperor Theodosius, by careful management, was enabled to receive the voluntary submission of the whole of the Visigoths.

Crown Imperial.

FRITIL'LARY (Fritillaria), a genus of plants belonging to the order Liliaceæ. Of this genus the Common Fritillary (*Fritillaria Meleagris*) is a native of Britain. It inhabits meadows and pastures, and is found throughout Europe. It has flesh-coloured flowers, with numerous dark and sometimes white spots. The Crown Imperial (*Fritillaria imperialis*) is a favourite in gardens. This genus is nearly allied to both the lily and tulip. The characteristics are the nodding flowers, the bell-shaped corolla with a nectary above the base of each segment, and the basi-fixed anthers. There are about forty species, including Amblirion of North America, natives of the temperate regions of the northern hemisphere. The species are often cultivated in gardens on account of their flowers. They blossom in April and May, and will grow in any common garden soil.

FRITIL'LARY is a name given to some species of BUTTERFLIES belonging to the extensive family Nymphalidæ, from the resemblance in the colouring of the wings to the flowers of the plant noticed in the preceding article. Many species of fritillaries are found in Britain. In the genus Argynnis there are six British species, in which the wings are tawny, with black spots and streaks on the upper surface; the under surface is similarly spotted or streaked with silver. The distribution of this genus is wide, but it occurs sparingly in South America and not at all in Africa. The caterpillars feed as a rule on violets. Another genus of fritillaries represented in this country is Melitæa. The three English species differ from those of Argynnis in the under surface of the wings being devoid of the beautiful silver spots.

FRO. See FREYER.

FROB'ISHER, SIR MARTIN, an enterprising English navigator, was born at Doncaster in Yorkshire, but it is not known in what year. He very early displayed the talents of a great navigator, and was the first Englishman who attempted to find out a north-west passage to China. After fifteen years of continued disappointment, the Earl of Warwick and others enabled him to fit out three ships in 1576. As he passed Greenwich Queen Elizabeth commended them, and bade them farewell, waving her hand to them out of the palace window. On the 11th of August he entered the strait now known by his name, and stopped at various islands. At Butcher's Island they lost a boat and five men through the treachery of the natives. He returned to Harwich on the 2nd of October, bringing with him, in token of possession, a piece of black stone like sea-coal, which was supposed to contain gold. A second expedition was fitted out, consisting of a queen's ship and two barks. They sailed 31st May, 1577. On the 19th of July they reached Hall Island, in Frobisher Strait. They returned to England in September. Commissioners were then appointed to report upon the whole affair, whose decision was most favourable. Three ships were prepared to seek the passage, while twelve others were to proceed to the island for ore. Frobisher, now lieutenant-general, again departed from Harwich, on 27th May, 1578. Ore was duly collected, but the season was unfavourable for discovery. He returned to England in October.

In 1585 Frobisher accompanied Drake in his expedition to the West Indies. In 1588 he so distinguished himself against the Spanish Armada, that he was knighted on board his own ship by the lord high-admiral. Two years later he commanded a squadron on the Spanish coast. In 1594 he was sent to Brittany, in aid of Henry IV. of France, when, in an assault on the fort of Croyzon, near Brest, he was wounded in the hip on the 7th of November, and died at Plymouth, after safely bringing back his fleet.

FROEBEL, FRIEDRICH AUGUST WILHELM, a famous educational reformer, best known as the founder of the KINDERGARTEN system, was born on the 21st of April, 1782, at Oberweissbach in Thuringia, in the small principality of Schwarzburg-Rudolstadt, and died at Liebenstein in the same country seventy years later. Pestalozzi, his predecessor and friend, had a fatherless childhood; Froebel, a motherless. Losing his mother in infancy he suffered keenly the want of that mother's love, which Pestalozzi received to his bane in such exuberant excess. But Froebel always attributed to his mother the imaginative and tender loving spirit which it was his joy to possess, and which all the coldness, and worse, of his stepmother was powerless to freeze. He escaped into the woods and fields from a severe father, a rigid puritanical clergyman, and a stepmother of the fairy-tale kind, and nature was his chosen friend and comforter.

At ten years old his uncle Hoffmann in Stadtilm took pity on the neglected child, and made his boyhood happy with family love and school training. But the boy could not reconcile the teaching, which was of the old-fashioned sort, with his beloved nature. "Geography," he says, "we learned parrotwise, with many words and little understanding: it was sufficient if we could name correctly our little patches of colour on the map. There was no link, not the very weakest, to couple it with the realities of life—all was in the air, without root or meaning." Money lacked somewhat, so instead of going to the university like his brothers, Friedrich was apprenticed to a forester, and spent three years at Neuhaus, from fifteen to eighteen, face to face with nature as in his childhood. "With nature and my mathematics," says he, "I was truly happy." But as to his calling, his master being ignorant and careless, he knew little more at the end of his three years than he did at the beginning.

He at last prevailed on the trustee of some little property of his mother's to give him his share, and with it he attended the University of Jena for two terms in the year 1800, when he was eighteen. His money only lasted so far; in fact it did not last so far, since we learn that he spent nine weeks in prison for debts incurred for his meagre dinners and his university dues—a time of enforced leisure which he diligently used in improving his Latin. At twenty his father's death threw him upon the world; and he tried accountancy and private secretaryship successively, to drift finally towards architecture as a profession. Going with this view to Frankfurt, he made acquaintance, while giving lessons for his maintenance, with Gruner, head of the Normal School.

Gruner soon found that he had secured a prize. Froebel's class became the model class; he felt, he says in a letter to his brother, at once in his element when he stepped before his class of thirty or forty boys—"the fish was in the water." But the old difficulty as to the want of connection between the school training and the world of nature pressed upon him. Gruner, to help his earnest friend, lent him Pestalozzi's works—a costly gift to Gruner, for it drove Froebel away into the welcoming arms of that kindred soul.

Pestalozzi was at Yverdon; and Froebel having been offered the charge of some neglected boys of the Von Holzhausen family, left his friend Gruner and carried off his new pupils in 1808 to Pestalozzi. Here he worked for three years with growing love and admiration for the great teacher; but also with a growing feeling of the deficiencies in his method, the want of steadiness, the absence of reasoned system, the failure to make education grow by development *as a whole*, and above all, the absence of provision for the creative and formative element of man's nature, whereby he expresses outwardly what he feels inwardly. Pestalozzi had, however, given the golden rule of teaching—to proceed from the easy to the difficult, from the known to the unknown, from the simple to the complex, from the near to the far, and this entitles him to our lasting respect.

Froebel was quick to see where Pestalozzi was deficient, but he saw also his own shortcomings, and to remedy these he underwent considerable privation to complete his university training; and in 1811 and 1812 we find him at Göttingen and at Berlin. In 1813 Bonaparte tottered on his throne, and Froebel, like many another student and philosopher, left the lecture-room for the battlefield.

At the close of the war Froebel, always a lover of crystals, accepted a post in the Mineralogical Museum at Berlin, and resumed his university studies. He says: "Returning again to the university, I feel with increased force the uselessness of learning by rote, learning from the outside; man cannot divest himself of his manhood—he must work, must *act out* his thought. Montaigne had said 300 years before—a beam of light piercing the darkness of the middle ages—"Sçavoir par cœur, n'est pas sçavoir" (To learn by heart is not [truly] to learn); but it

was in Froebel's bosom that the fruitful seed was warmed into life.

Christopher Froebel, his brother, died in 1816, leaving three sons; and Friedrich, taking charge of them with two other nephews, felt that his time had come at length. He summoned Middendorff and Langethal, two fellow-soldiers in the war; and together, first at Griesheim and eventually at Keilhau, now so well known through this circumstance, they established their school of the new education. The school became famous, and in 1823 Barop, a nephew of Middendorff, joined them, and brought with him that needful practical business element, hitherto somewhat wanting, through which the school has lasted till our own day, and is still renowned and flourishing. Young teachers came from far and near to study this new and fascinating system of education by natural development.

Meanwhile Froebel, invited by Schnyder, the musical composer, began anew in 1831 at Willisau, Switzerland. Leaving Middendorff over the school thus founded, Froebel accepted an invitation by the Canton of Berne to take charge of an orphan asylum at Burgdorf. He began here lecturing to teachers, and at one time had as many as sixty students attending his lectures. It was here, too, that his wonderful games and occupations for children began to take form.

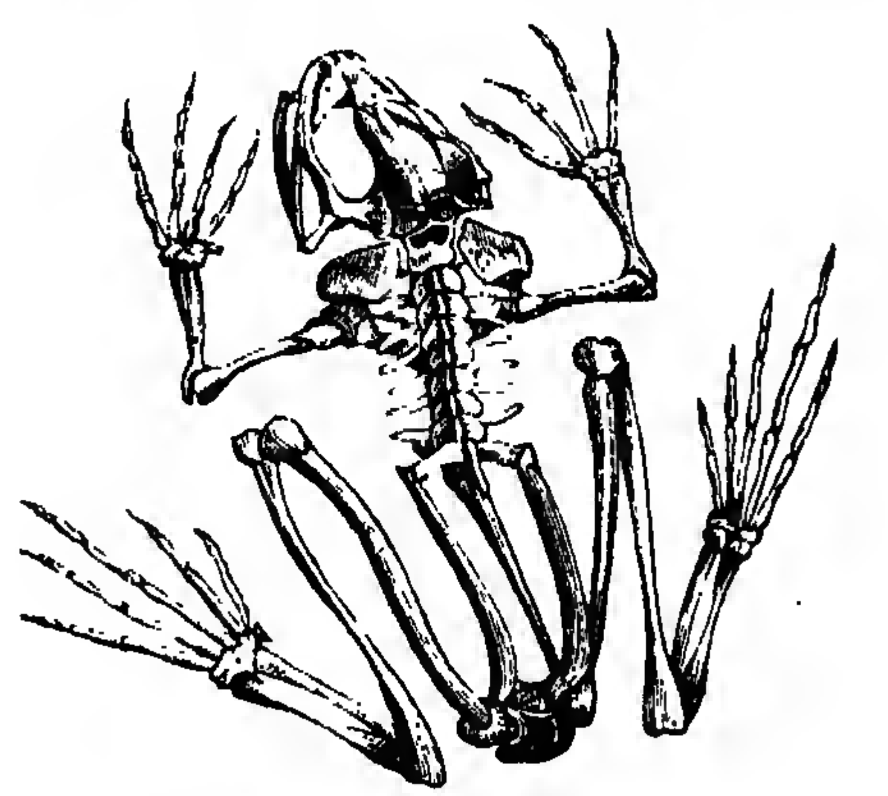
Froebel felt still unsatisfied with what all others considered wonderful educational results. He sought for better teachers; and still he found, with faultless teaching, school-time too short to give all the instruction necessary for life. He then turned to the pupils, and perceived at last that it was quicker learning, not better teaching, that was necessary. Following this new clue, he observed the absolute waste, and worse than waste, the misuse of the years of childhood, that childhood which he had come to consider the most valuable and important part of life. The difficulty was how to gain the ear of tiny children, and after prolonged thought the solution came to him as a new revelation; he had to approach the children through their toys and games by means of the purest and tenderest influence this world yields—the mother-instinct of a gentle woman. Eagerly he founded at Blankenburg, in his native Thuringia, the first Kindergarten for children beneath school-age, on the four-hundredth anniversary of the invention of printing, in 1842, when he was sixty years old.

The flame was thus set to the beacon, which soon blazed aloft, and eager followers in neighbouring countries were gladly visited and encouraged by the enthusiastic old man. He returned in the spring of 1847 to his beloved Thuringia, and settled at Liebenstein, devoting himself as a man of sixty-five to the training of young girls in all the charming methods which he had invented for the education of children; and cheered by the friendship of noble women such as the Baroness von Marenholtz-Bülow. Through the influence of the baroness the Duke of Meiningen gave Froebel his villa at Marienthal for a training institution.

Prussian reactionary despotism disapproved of these new principles, and seized the opportunity of an educational pamphlet by a nephew, Karl Froebel, advocating secularist views, to decree the abolition of all Kindergartens in Prussia. In vain Friedrich protested that he was not Karl, nor shared his opinions. The Kindergarten was crushed out rigorously, and Prussian authority was used also in the neighbouring states to discourage the system. It is no exaggeration to say that this was a deathblow to the venerable enthusiast. A poor consolation was afforded him by the unanimous uprising of the schoolmasters in Germany, in congress assembled, to do him honour as he entered; he could not survive the act of Philistinism. It had been coupled, too, with the calumnious charge of irreligion against one whose whole life was a prayer, and who hardly ever wrote a page without a reference to the Source of all goodness and life. He died 21st June, 1852. In 1882 the Froebel Society of London celebrated with some ceremony the anniversary of their master's birth. This society is the recognized centre of the Kindergarten movement in England, and was founded by disciples of Froebel himself. It contains all the friends of higher education, and operates chiefly by inspecting Kindergartens and by providing annually a severe examination for Kindergarten teachers. Two such examinations are necessary to earn the society's certificate, which accordingly is highly prized.

Froebel was a man over middle height, thin, and eager looking. His forehead was broad, but his hair grew low down towards his massive eyebrows, deep under which lay the large flashing eyes, now brilliant with prophetic fire, now moist with tenderness as the spirit struggled to give itself expression in words—a task which Froebel perhaps never fully accomplished, his style being sometimes mystical and involved to the verge of unintelligibility. The high-bridged thin nose dominated the face; the thin-lipped mouth was usually firmly closed. A pointed chin completes the description of a most striking, if not lovely, physiognomy—one which had great power and fascination over those dear to its wearer and to whom he was dear. He walked fast; when excited, with giant strides. He would rush across a field as if possessed to gaze on the face of a far-off child, drawn by an irresistible attraction. This intense love was returned to the full, and he was to children an object of adoration. With men he was often deceived, for he never lost the simple faith of childhood—he rejoiced, he played to the last like a child. His favourite cry was, "Come, let us live for our children." It is to such a man that we owe the priceless gift of the Kindergarten for our little ones.

FROG is the common name of a group of Amphibians, forming with the toads the order BATRACHIA. Broadly this order may be divided into three groups—Frogs, TREE-FROGS, and TOADS, with the first of which this article is mainly concerned. In these animals the form of the body is broad, short, and depressed; the limbs are four, of



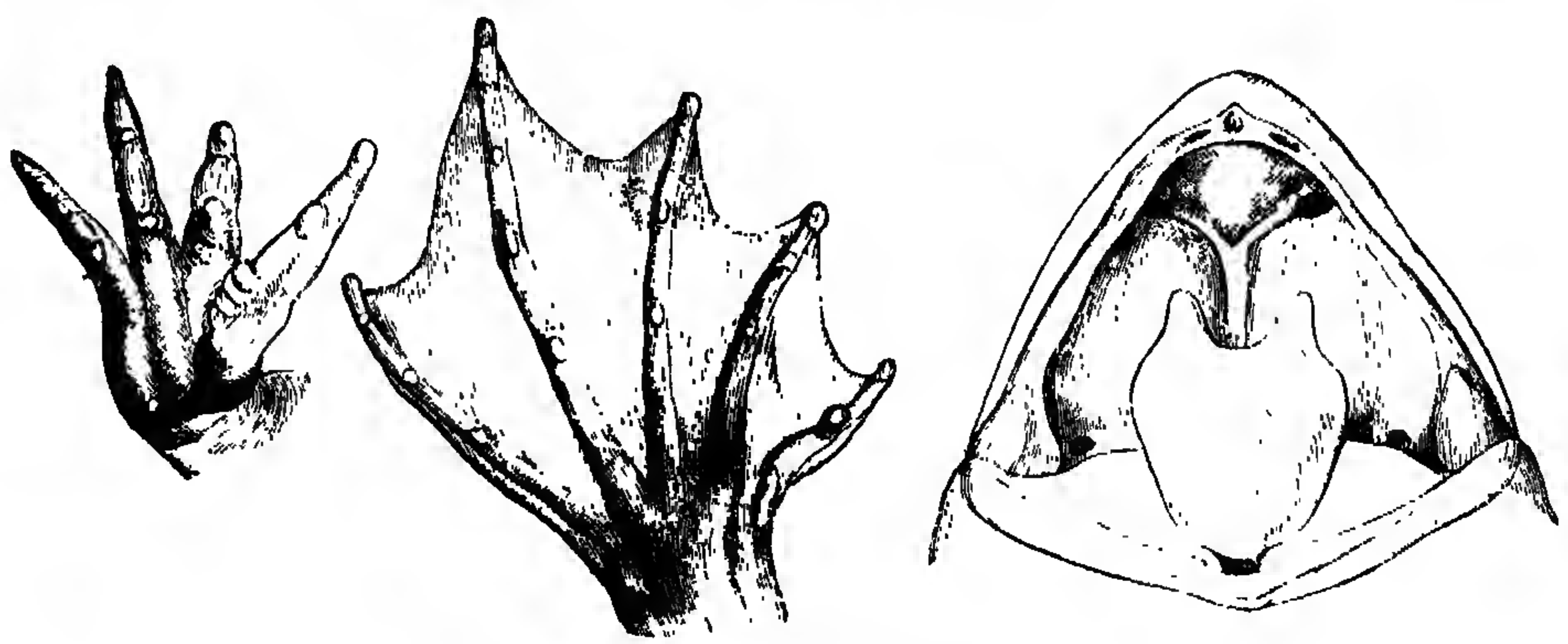
Skeleton of Common Frog.

which the hinder are far longer and more muscular than the anterior; the head is flat and broad, the gape wide, the cerebral cavity small, and yet the brain scarcely fills it. The vertebræ are usually nine in number; the tail part of the vertebral column is in the form of a long bony unsegmented style (*urostyle*). The vertebræ are concave in front and convex behind (*procœlous*), with the exception of the eighth vertebra, which is doubly concave (*amphicœlous*), and the ninth vertebra, which is convex in front and has two convex tubercles behind. Ribs are quite absent. The sternum is highly developed, and a large portion of it is

often cartilaginous; it receives the two clavicles and the coracoid bones, which support the scapulæ. The bones of the forearm, *radius* and *ulna*, are united into one. The thumb is quite rudimentary. The pelvic girdle for the support of the long and powerful hind limbs is well-developed. The *tibia* and *fibula*, the bones of the leg, are united. The *astragalus* and *calcaneum*, forming the ankle (*tarsus*), are greatly elongated. The hind foot has five long and slender digits.

In the frogs teeth are found only in the upper jaw, attached to the premaxillary and maxillary bones and to the vomers. The muscular system is well developed, the muscles of the thigh and leg particularly so, presenting a great analogy to those of the human subject.

The food of these reptiles consists of slugs, insects, aquatic larvæ, worms, &c. In the frog the tongue performs a leading part in the appropriation of their living food. This organ, which is soft and fleshy, and lubricated with a glutinous saliva, does not rest upon anything analogous to the hyoid bone, but is fixed to the inner part of the front of the lower jaw, so that when in repose its base is anterior, and its apex points towards the gullet, just the reverse of the ordinary position. When the animal darts it forth at its prey, it becomes considerably elongated, and turns on the pivot of its anterior fixture, being reversed in such a manner, that the surface which was undermost when the tongue was lying in a state of repose in the mouth is, during this action of darting forth, the uppermost; and the original position is gained instantaneously, when, laden with its tiny victim, it turns on its pivot again into the mouth, delivering its load into the pharynx. The rapidity with which this organ is launched forth at insects or slugs is very extraordinary; the eye can scarcely follow the movement; the aim is never missed; the prey, being touched by the tongue, adheres to it by means of the viscid saliva, which is very tenacious, and is shot back into the pharynx. The hind legs are much longer than the front pair, and the hind feet are webbed. These powerful hind legs are the chief organs of locomotion both on land and in the water, both in leaping and in swimming; the leaping powers of the frog, as is well known, are enormous. Respiration in the adult animal is chiefly carried on by means of two large lungs. As the ribs are quite rudimentary the process differs from that of other lung-bearing animals. The air is *swallowed* down, so to speak, being taken in through the nostrils, the mouth being closed; it is then forced down into the lungs. This explains the fact that the easiest way to suffocate a frog is to keep its mouth open and let the air, which should enter the lungs, escape. The delicate naked skin co-operates with the lungs, affording an extensive surface for the aeration of the blood in the minute capillary vessels. This cutaneous respiration



Mouth and fore and hind feet of *Rana occipitalis*.

can only take place, as various experiments tend to prove, while the skin is bedewed with moisture; hence the abundant secretion of fluid for the purpose of preserving its necessary degree of humidity; for in hot weather, even when the frog has no access to water, its skin is wet; and a peculiar sac, erroneously regarded as the bladder, serves as a reservoir of pure fluid for the supply of the system with the moisture necessary to the continuance of the vital operations. The skin not only exhales, but also absorbs water.

These animals are generally found in moist places, in the grass of meadows, and on the banks of streamlets, into which they continually leap and dive. In summer, during or after warm rain, they make their appearance in our meadows in such vast quantities, that many people have imagined that it had rained frogs. This is an ancient belief, and is still in full credit in the provincial parts of many countries of Europe. The males of some species, especially the edible or green frog, have two sacs called vocal pouches, on each side of the throat, which in general are only manifested externally by the swelling which is produced in them when filled with air. These animals have a peculiar and sonorous cry, louder and stronger in the species with the vocal sacs, which is known in this country by the name of croaking. It is chiefly during rain in warm weather, and in the morning and evening, that this noise is heard, which must be familiar to every one. The croaking of frogs is not a whit more musical than it was when their "brekekekex-koax-koax" grievously annoyed Dionysus on his passage in Charon's boat over the lake of Acheron (Aristophanes' "Frogs"). In autumn, when the summer heats are over, these animals appear to lose their voracity, and cease to take food; and when the cold becomes more considerable, they protect themselves from its rigour by sinking into the mud of deep waters, or by taking up their abode in holes on the banks of streams and ditches. They sometimes assemble in one place in such quantities as to cover the soil to the depth of a foot, and thousands may thus be taken in a few minutes. They pass the winter in a state of complete torpidity. In the tropics during exceptional heat or drought this *hibernation*, or more correctly in this case *æstivation*, also obtains. In this country they revive upon the return of spring, and emerge from their winter retreats to recommence a life of activity and obey the grand law of nature—the reproduction of their species. The arrival of the season for this important function is shown in the male by the appearance of a black wart on the fore feet and the belly swelling. The male frog leaps on the back of the female, to whom he clings by the aid of

these warts on his fore feet. During the cohesion of the two sexes, which lasts for a considerable period, sometimes for fifteen or even twenty days, the female commences depositing her eggs, which are fecundated during their passage by the seminal fluid of the male. When first expelled these eggs are little black specks, each enveloped by a thin layer of viscid albumen, secreted by the oviduct. This envelope swells up greatly in the water after the eggs are laid, and gives rise to the glairy gelatinous mass in which the eggs are for some time imbedded. The eggs are, in the case of the common frog of this country, deposited at the bottom of the water, and then float on to the surface, and are left there to hatch by the ordinary temperature of the atmosphere. The eggs contain a quantity of food material. The rate at which the development of the embryo takes place varies in accordance with the temperature; in England the embryo takes about a month in hatching. While the embryo is still within the egg it is seen to have a fish-like form; limbs are absent, and the gills are rudimentary. The development of the frog within the egg has been carefully studied, and will be treated with more detail in the article VERTEBRATA. When it emerges from the egg as the well-known tadpole (see Plate FROGS, figs. 2 and 5) it has no limbs, but seems to consist of nothing but head and tail. Respiration is carried on by means of three pairs of external gills (branchiæ) having the form of branched filaments. The heart is two-chambered, as in fishes. The mouth has a horny beak adapted for feeding on the vegetable matters in the water. In accordance with these vegetarian habits the intestine is very long and coiled; in the adult frog, which is carnivorous, the intestine is relatively shorter and comparatively straight. At the roots of the gills are narrow clefts, the gill-slits, leading into the pharynx; through these slits passes out the water taken in at the mouth. The external gills and the gill-slits are gradually being hidden by an opercular fold. The external gills now atrophy, their place being taken by internal gills. The first gill-slit is still naked. In these early stages of the frog's history the large muscular tail induces vigorous locomotion. It is some time before the legs appear; the hind pair appear first, owing to the fore pair being hidden under the opercular membrane. As time goes on the limbs increase in size and the tail decreases, being gradually absorbed. The lungs are developed and the heart becomes three-chambered. The horny beak is lost and teeth are developed. The animals grow very rapidly, and soon leave the water for the dry land and assume carnivorous tastes, feeding on worms and insects.

The skin of frogs is usually quite naked and smooth; in the genus Ceratophrys (fig. 3) bony plates are developed in the integument, and the upper eyelids present the appearance of short sharp-pointed horns.

The Common Frog (*Rana temporaria*) is the only species of frog indigenous to Britain. Though now plentiful in Ireland these frogs are not natives of that island, but were introduced about the beginning of the eighteenth century. This frog is tolerably abundant throughout all Europe, and lives much on land during the summer season. In this country it is found in moist meadows and gardens; and while the Green Frog (*Rana esculenta*) rarely forsakes the water, this species must be sought for among bushes and long grass, even a long way from the neighbourhood of streams. The male does not possess the vocal sacs, and from its not, in consequence, having such a loud croak, it has been sometimes called the mute frog. It does, however, emit this sound, but chiefly when under water. The common frog is of a brown colour, inclining more or less to yellowish or reddish-brown on the upper side, spotted irregularly with black, brown, or brownish-gray, with transverse bands of the same colour on the legs. The under surface is yellowish-white, sometimes with spots similar to those on the back, but smaller and fewer. One of the most characteristic marks of the species is an elongated patch of brown or brownish-black behind the eyes on each side, and extending from the eye to the shoulder. It is from this distinguishing mark that it has obtained the name of *temporaria*, in allusion to this patch on the temples. This species has a very wide distribution, being found in the temperate regions of both hemispheres, and extending in Asia as far as China and Japan.

The Edible or Green Frog (*Rana esculenta*, see Plate, fig. 1) is rather larger than our common frog. It varies very much in colour, according to the locality in which it is found. In general the upper parts of the body are of a beautiful green tint, irregularly marked with brown or blackish spots or patches of nearly equal size, the limbs being marked transversely with bands of the same colour. It differs from the preceding species in wanting the dark mark extending from the back of the eye to the shoulder, and in having three distinct narrow bands, of a fine golden yellow, running down along the back. The male is distinguished by having a vocal sac on each side, behind the angle of the mouth. When filled with air in the act of croaking, they become large and globular, standing out, one on each side of the head. The edible frog is essentially aquatic in its habits. It is the common frog on the Continent. It was first observed in England in a fen in Cambridgeshire in 1843; it is not, however, indigenous to this country, but has been introduced from the Continent. It has a wide range, being found throughout Europe, in Northern Africa, Persia, China, and Japan. As the name denotes, this species is used as food. In France and some other parts of Europe the hind legs are dressed like fish and served with wine or white sauce, and are regarded as a great luxury; the flesh is very delicate, and resembles that of a rabbit or chicken. The BULL-FROG of North America (*Rana pipiens*) is remarkable for its croaking powers. Many other species of frogs are found in different parts of the world. None are found in oceanic islands. The TREE-FROGS (*Hylidæ*, fig. 4) are noticed separately.

FROG-FISH. See ANGLER.

FROG-HOPPER, FROTH-HOPPER, CUCKOO-SPIT, are common names for the insects whose larvæ are abundant on plants surrounded by a frothy substance which they secrete. These insects form the family Cercopidæ, which belongs to the HOMOPTERA, a suborder of insects which also includes the Cicadas and lantern-flies. In this family the hind legs are elongated and admirably adapted for leaping. The head has two ocelli. The antennæ are short and composed of three points. The upper wings are leathery. The frog-hoppers, the perfect insects as well as the larvæ and the pupæ, live on trees, shrubs, and plants, on the juice of which they feed. The frothy secretion resembles saliva; the popular beliefs concerning it are expressed in the various names given to these insects. It is secreted by peculiar organs in the tail of the larva. This exudation protects from the heat of the sun the soft body of the larva, which but for this would soon shrivel up; and also conceals it from birds and many insects, which would otherwise prey upon it. Notwithstanding the concealment, wasps often get at these larvæ and carry them off. The frog-hoppers are distributed all over the world. Some of the exotic species are large and beautifully marked. Of the typical genus Cercopis there is only one British species. The frog-hopper most common in this country is *Aphrophora spumaria*, which especially haunts willows. It is about half an inch in length, of a brownish-gray colour. A smaller species, *Aphrophora bifasciata*, abounds in gardens, infesting particularly rose-trees.

FROISSART, JEAN, a celebrated French poet and historian, was born at Valenciennes about the year 1337. He was the son, as is conjectured from a passage in his poems, of Thomas Froissart, a herald-painter, no incon-

siderable profession in the days of chivalry. He was brought up for the church, received a learned education, and became an ecclesiastic. At the age of twenty, at the command of his "dear lord and master, Sir Robert of Namur, lord of Beaufort," he began to write the history of the French wars. The period from 1326 to 1356 was chiefly filled up from the Chronicles of Jean le Bel, canon of Liège, a confidant of John of Hainault, and praised by Froissart for his diligence and accuracy. The remainder, up to the year 1400, was the result of his own observation and knowledge, derived in great part from his actual presence in or near the scenes he describes. The value of such a book from a man of such ability in reproducing what he saw is of course very great. He came to England in the train of Philippa of Hainault, the admirable wife of Edward III., and acted as her secretary. In 1366 he was at Bordeaux, at the time of the birth of the Black Prince's son, afterwards King Richard II. He suffered much in 1369 by the loss of his patroness, the Queen Philippa. Having obtained the living of Lestines, Froissart returned for a time to his own country; but he was soon wandering again, and became secretary to the Duke of Brabant, whose songs, &c., with some of his own, Froissart collected into a kind of romance, called "Meliador." The duke dying in 1384 Froissart obtained another patron, the Count of Blois, and was sent by him to the court of Gaston de Foix, purposely to enrich his history. Froissart's narrative of this visit is one of the most interesting things in literature. In 1395 he was again in England, and in the court of Richard II., from whom he received a silver goblet containing a hundred nobles, and whose fate formed the tragical subject of Froissart's last labour for his history. He is supposed to have died at Chimay, where a benefice had been given him. The exact date of his death is unknown. The best English translation of Froissart's Chronicle is that by Lord Berners (1525–26, reprinted in 1812). Some splendidly illuminated manuscript copies, quite or nearly contemporary, are in the British Museum.

FROME, or **FROME SELWOOD**, a busy and prosperous market-town and parliamentary borough of England, in the county of Somerset, 12 miles S. from Bath, and 106 from London by the Great Western Railway, is situated partly in a deep hollow and partly on an irregular acclivity, on the western side of the river Frome, over which is a good stone bridge. The town is irregularly built, and the streets, except two which are the great thoroughfares, are narrow, "dividing and contracting as they run up the hills, like the tributaries to a stream." The river is lined with fulling, rolling, and other mills. Frome has long been celebrated for the excellence of its ales. There are some large establishments for the manufacture of woollen cloth and silk. The market-house is of modern erection. The parish church (St. John's) is handsome and spacious, with an embattled tower, surmounted by a spire. At the east end is the tomb of Bishop Ken, one of the seven prelates committed to the tower by James II., and author of the well-known "Morning and Evening Hymns." There are several other churches, chapels for dissenters, banks, a handsome police station, mechanics' hall, a museum and library, a school of art, &c. The free grammar-school is of the foundation of Edward VI. There are asylums for the maintenance, education, and apprenticing of poor girls, a charity school for boys for the same purpose, and well-endowed almshouses. Selwood was part of Woodlands Forest. Four miles from the town lies Longleat, in Wiltshire, the beautiful seat of the Marquis of Bath. The borough returns one member, the privilege having been first conferred on it by the Reform Act of 1832. The number of registered electors is about 1400, and the population in 1881 was 9377. In 705 a monastery was built here by Aldhelm, kinsman of King Ine. It was afterwards destroyed by an inroad of the Danes.

FRONDE (Fr., from *frondeur*, a declaimer against government), the name of a political faction in France during the minority of Louis XIV., which was hostile to the prime minister, Cardinal Mazarin, and to the queen-regent. In consequence of a quarrel with the Parliament of Paris, on the subject of some taxes, the cardinal ordered the arrest of the president and of a councillor in August, 1648, when a civil war broke out. Among the leaders of the Fronde were the dukes of Beaufort, Némours, and Vendôme, Marshal Turenne, &c.; and they were supported by the Parisians, who erected barricades across the streets, and obliged the queen to liberate the two members. This was called "the day of the barricades." In January, 1649, the queen-regent and the young king removed to St. Germain, and left Paris to be blockaded by the Prince of Condé. Mazarin was outlawed by the Parliament. After some fighting a truce was made and the king returned to Paris. In the provinces the disturbance continued. In 1650 the queen-regent made her peace with some of the Frondeur leaders, and arrested the Princes Condé and Conti, when Marshal Turenne and others raised a new and more serious revolt, which continued till 1653, when Turenne negotiated and Mazarin returned in triumph.

FRON'TISPIECE, the front or principal face of a building; the front-view; anything seen in or at the front. Johnson says, "Id quod in fronte conspicitur;" hence, by a metaphor, the term is most usually employed to describe the engraved title of a book or the print which faces the title-page. It should of course be *frontispice*, and the present corruption is a favourite example of FOLK-ETYMOLOGY.

FROST, HOAR. See HOAR-FROST.

FROST-BITE. The effects of severe cold are scarcely less dangerous than those of heat, and in Arctic regions very severe consequences result from frost-bite. The part of the body thus affected becomes first blue and swollen, then of a tallowy whiteness, and if not judiciously treated it turns black and becomes mortified. In Britain aggravated cases seldom occur. but in countries noted for great winter severity of climate fingers, ears, and toes are not unseldom lost from this cause. In this country the most common effect of frost-bite is that known by the name of CHILBLAIN. The treatment of frost-bite consists in restoring the circulation to the part by extremely slow and gradual means, which is best effected by means of friction at first with snow, then with ice-cold water, and then with water at the ordinary temperature. As sensation is restored a powerful tingling is felt, which is followed by heat and inflammation. The patient should be kept from the fire and from artificial heat until sensation and colour are fully restored. It should be remembered that the too sudden application of heat is one of the principal causes of chilblains. In addition to its local effects severe cold has sometimes the effect of depressing the vitality of the whole body, producing a feeling of drowsiness and insensibility which, if yielded to, is generally followed by death. When this result of cold is observed every effort should be made to rouse the energies of the patient, and to keep him awake until shelter and aid can be reached. Where insensibility has set in, moderate warmth and energetic friction are the best means of restoring the suspended vitality, and artificial respiration may be had recourse to for the same purpose.

FROTH-HOPPER. See FROG-HOPPER.

FRUC'TIDOR (literally "fruit-month") was the name given in the republican calendar of the French Revolution to the period included between the 18th of August and the 16th of September. See CALENDAR.

FRUIT, in botanical language, signifies that part of a plant in which the seed is lodged, whatever its size, colour, or texture may be, so that the seed-like grain of a sage, the grain of corn, the nut of a chestnut, the dry capsule of

a lilac bush, are as much fruits as those of a peach, an apple, or a pine-apple. The fruit may consist of the single mature ovary or of several ovaries, of the ovary with calyx or other part attached or of an inflorescence when the parts have become compacted.

The simpler forms result from a single pistil. In these the ripe ovary is the seed-vessel or pericarp. Alterations take place during the maturing of the pistil. Thus the ovary of the oak contains three cells with two ovules in each, but the fruit contains only one seed in a single cell, the rest having become aborted. In the apple the calyx adheres to the ovary, and becomes part of the fruit.

The pericarp may remain leaf-like, as in the pod of the pea. In stone-fruits, such as the plum, the pericarp is differentiated into three layers; the outer or skin is called the epicarp, the flesh of the plum is the mesocarp, and the inner layer or stone is the putamen. The opening of the pericarp to discharge the seed is called the DEHISCENCE.

In the ordinary acceptation of the term the word fruit is exclusively applied to seed-cases which are eatable, and generally to such as require no preparation to render them fit for food. The species of cultivated fruits are numerous, and most of those of the temperate regions have been introduced, at one period or another, into Britain. They are nearly all noticed in special articles.

Apples are the most numerous class in cultivation. It has been conjectured that they were brought to this country by the Romans; but it is doubtful whether the varieties then introduced would succeed in this climate. A hardier breed, it is more than probable, was introduced by the Normans, especially of such as were suited for the manufacture of cider.

Of the varieties of *pears*, few till lately have originated in this country. Most of the kinds in former cultivation were from France, but they generally required the protection of walls. The greater intercourse with the Continent, consequent upon the establishment of peace in 1815, led to the introduction of a number of new and hardy varieties from Belgium, where their cultivation is attended to with great assiduity. These new varieties, with some of equal merit, and even superior hardiness, raised within the last few years, now compose the principal part of the most select lists, and are at the same time rapidly excluding the old French varieties from cultivation.

Cherries, it is said, were first cultivated in this country at Sittingbourne, in Kent, where they are supposed to have been introduced about the time of Henry VIII. That county is still famous for a sort called the Kentish cherry, identical with some of the varieties of the Montmorency cherries of the French. They are round, bright red, and acid, and much used for pies.

Apricots in cultivation are of few varieties compared with any of the preceding kinds of fruits. The apricot blossoms earlier than any other fruit-tree cultivated in this country. In consequence of this its blossoms, particularly in the case of young trees, are extremely liable to drop off in setting.

Peaches and *nectarines* require the aid of a wall to bring them to perfection in this climate; and in the more northern counties of Britain the protection of glass is also requisite. They rank among the kinds of fruits which are considered of sufficient value to be forced.

The best variety of *quinces* is the common one. The Portugal quince is distinct, but its fruit does not ripen so well in this climate as the common one. Its wood, however, swells more in conformity with that of the pear, and it therefore is preferable as a stock for pears.

The principal varieties of the *medlar* are the large or Dutch, the upright or Nottingham, and the stoneless. The first is esteemed for its size, and sometimes for the form of the tree, on account of the rustic crooked appearance which it assumes. The second is of better quality as regards flavour; the third is small, without stones or seeds, and keeps longer than the others.

The *mulberry*, originally introduced from Asia, succeeds well in the south of England, but in the north it requires a wall. The fruit is much esteemed for dessert. The leaves are sometimes used in the south of Europe to feed silkworms.

Raspberries compared with many of the fruits mentioned above, differ little in their character as cultivated varieties from that of the botanical species, *Rubus idæus*, from which they have arisen; for instance, the difference between the wild sloe and the greengage is very great, whereas the wild raspberry growing in the woods differs only slightly in flavour, and not widely in size and form, from those cultivated in gardens.

Strawberries have been considerably reduced in regard to the number of varieties in cultivation, by the introduction of good varieties.

Grapes are brought to high perfection in this country by the aid of hothouses. In favourable situations some kinds ripen pretty well, even on walls, in good seasons; but open vineyard culture is not practised to any extent in England at the present time, nor is it likely ever to become profitable.

The *fig* in some parts of England bears in the open air, but in order to insure its doing so a warm, or more strictly speaking, a dry subsoil is absolutely necessary, whether it be grown as a standard in the open ground or against a wall, or forced under glass. Figs succeed well in Sussex, where the subsoil is chalk, and the rain passes off as it falls. In preparing borders for it the whole should be composed of such materials as are pervious to water.

Gooseberries are brought to greater perfection in Britain than in any other country. The varieties are numerous.

The varieties of *currants* preferable for cultivation are very few.

FRUIT-BAT is the name given to the species of the family Pteropidæ, a family quite distinct from other bats both in habits and structure. The distinction is so well marked that it is usual to give this family the rank of a suborder under the title Megachiroptera (great bats), all the other families falling under the suborder Microchiroptera (small bats). These bats, as their name denotes, feed on fruits. They are usually of large size. Their heads are elongated and hairy. The molar teeth have flattish tuberculated crowns, with a central longitudinal groove. The ears are not furnished with a *tragus*, the little lobe guarding the inner ear so well developed in some bats. The forefinger consists of three phalanges, the last of which is generally armed with a claw. The tail is frequently wanting, or, when present, very short, the abrogated interfemoral membrane being represented by narrow folds connected with the inner margin of the legs. The pyloric extremity of the stomach is generally greatly elongated. These bats have a wide geographical distribution over the eastern hemisphere.

The typical genus Pteropus includes more than half of the fruit-bats. Forty-one species have been described. They are called flying foxes by the European residents in India and elsewhere. The largest species is the KALONG (*Pteropus edulis*), a native of Java; the body is 2 feet long, while the expanse of the wings from tip to tip is 5 feet. In the genus Pteropus the tail is entirely absent, the muzzle is long and pointed, and the tongue is of moderate size. The dental formula is

$$I. \quad \frac{1-1}{1-1}, \; pm. \frac{3-3}{3-3}, \; m. \frac{2-2}{3-3} = 34.$$

This genus has a very wide geographical distribution. The species are particularly abundant in Australia and the Malay Archipelago, and extend through Southern Asia to the

Seychelles Islands and Madagascar. No species are found in Africa. The Indian Flying Fox (*Pteropus medius*), inhabiting most parts of India, is one of the best known of this genus. These bats, like the rest of the family, feed on fruits, being especially fond of figs and almonds. Of their moral character it is impossible to speak very highly, for according to Mr. Francis Day they "often pass the night drinking the toddy from the chatties in the cocoa-nut trees, which results either in their returning home in the early morning in a state of extreme and riotous intoxication, or in being found the next day at the foot of the trees sleeping off the effects of their midnight debauch." The flesh of this bat is said to be delicate, and is often eaten in India.

The genus Cynonycteris extends into Africa. One species, *Cynonycteris ægyptiaca*, is found in the chambers of the pyramids and among ruins in Egypt; it has long been an inhabitant of that country, being frequently represented on Egyptian monuments. This genus has a short tail. The most important genera of fruit-bats besides those already mentioned are:—Epomophorus, Cynopterus, Harpyia, Cephalotes, Notopteris, Eonycteris, Macroglossus, and Melonycteris.

FRUIT-PIGEON (Carpophaga), a genus of PIGEONS found in India, the Malay Archipelago, and Australia. In this genus the bill is short, curved, broad at the base, and compressed at the tip. The tarsi are short and strong, having plumes below the heel. The middle toe is much longer than the side ones; the side toes are nearly equal. The wings have the third and fourth quills longest. The tail is even and broad. As an example of this genus the Magnificent Fruit pigeon (*Carpophaga magnifica*) may be taken. This bird, one of the most splendid of its tribe, is found abundantly in the south-eastern parts of Australia. It measures about 16 inches in length, and has the head and neck of a delicate pale gray colour, and the whole of the upper surface and wings rich golden-green, with bright yellow patches upon the greater wing-coverts and tertiaries, forming an irregular band across the wing; the tail is bronzed green; from the chin a deep purple line passes down the centre of the throat, and joins a large patch of the same rich colour, which occupies the breast and belly, and is followed behind by a band of orange-yellow covering the lower part of the flanks, the vent, and the thighs, while the under tail-coverts are greenish-yellow. It is a shy bird, but has a hoarse, loud, and monotonous note, by which its presence is often betrayed. Its food consists chiefly of wild figs and the fruits of palms, in search of which it passes nearly the whole of its time on trees.

FRUIT-TRADE. This trade comprehends both fresh and dried fruits. We have no means of ascertaining how much fruit is cultivated and eaten in this country, but all grown here is consumed at home. The readiness with which perishable goods can be carried to the best market, by means of rapid locomotion, has, in combination with the growing depression of ordinary agriculture, led to a large increase in the trade and in the attention paid to the cultivation of fresh fruits. The chief fruit-growing counties of England are Hereford, Devon, Somerset, Worcester, and Gloucester. About 21,000 acres are also devoted to fruit-growing in Kent, Cornwall, Surrey, and Lancashire, on what may be called the market-garden system. Strawberry farming has become an extensive business in Scotland, especially on the Muir of Blair, near Cupar-Angus. The returns from fruit-growing may be considered very fair, and the supply at present considerably falls short of the demand, while the increase of and improvements in the methods of preserving in large quantities have removed one of the chief elements of risk to a fruit cultivator. The chief place for the sale of fresh fruit for London consumption is Covent Garden Market, to which the many square miles of market gardens in the country suburbs contribute, as well as a daily supply brought in by the various railways. Oranges, lemons, and pine apples are brought in swift vessels from the countries in which they are chiefly produced, and are generally consigned to merchants in the neighbourhood of the Custom-house, who supply the markets, fruiterers, and street dealers. Dried fruits comprise currants, figs, raisins, &c. They are grown chiefly in the countries bordering on the Mediterranean, and are dried before exportation. The customs duty on the three kinds named, as well as on prunes and French plums, is 7*s.* per cwt. All other kinds are admitted free of duty.

FRUITS, PRESERVATION OF. The apple and the pear, two staple fruits of this country, are of so much importance to great numbers of persons, that we purpose giving some information as to the best means of preserving them during the autumn and winter, it being an object of some moment to be able to prolong the duration of these fruits even for a single month.

A few early varieties may be eaten from the tree, or when recently gathered; but the greater and by far the most valuable portion require to be kept for some time, until they acquire a proper degree of mellowness. Thus most pears are extremely hard when gathered; some even remain so during the winter, and only become melting, or of a buttery consistency, in the spring. Apples, although it is their property to remain a long time nearly as crisp as when gathered, yet are at first too acid for the dessert, and require to be stored up in the same manner as pears, until their juices acquire a rich sugary flavour. Many varieties indeed permanently retain their acidity, but such are only proper for culinary purposes, for which indeed their briskness renders them eligible.

With regard to the gathering and storing of apples and pears, having in view their most perfect preservation, it is necessary that the gathering should be performed in all cases when the trees and fruit are perfectly dry.

The treatment of the fruit after gathering is by no means uniform; some lay it directly on the shelves of the fruit-room, or wherever else it is intended to remain till fit for use; others cause it to undergo a process of fermentation, called sweating, by throwing it in a heap, and covering it with some dry substance, generally straw; in some instances even blankets have been used for this purpose. After it has perspired for ten days or a fortnight, it is spread out at a time when the air is dry, in order to expedite the evaporation of the moisture. All unsound specimens, or even such as are suspected of being so, are then separated. In the case of particularly valuable sorts, it has been recommended to wipe off the moisture with flannel; but this proceeding is not advisable. The modes of storing are so widely different, according to the circumstances of the individual, that we can only enumerate some of the most successful.

The fruit is placed in close drawers or on dry shelves; in casks, jars, or boxes plunged in dry sand; in heaps covered with straw; in close cellars excluded from the air, which is a very bad plan; or, as the American apples are very frequently packed, in powdered charcoal, which has a tendency to prevent decay. It is found that fruit keeps best when not exposed to the light, but in situations where ventilation can be secured. A large airy dry vault, therefore, or a fruit-room on the north side of a wall where the sun's heat will not easily penetrate, is, we think, the most desirable storehouse. Under all circumstances where fruit is not closely packed, it should be exposed to as little change of temperature, and the circulation of air be kept as dry, as possible.

Apples and pears dried in ovens may be preserved for years. Bose states that he has tried the latter after three years' preservation and found them still good, but they are best during the first year. They are placed in the oven after the bread is drawn. The process is repeated

a second, third, or fourth time, according as the size or nature of the fruit may require. The heat must not be so great as to scorch, nor must the fruit be dried to hardness. When properly done they are kept in a dry place. Another method, chiefly practised on the Rousselets, and of these the Rousselet de Rheims is the best for the purpose, is to gather the fruit a little before maturity. After being half boiled in a small quantity of water they are peeled and drained. They are then placed in the oven, and heated to a suitable degree, for twelve hours. Next they are steeped in syrup, to which have been added brandy, cinnamon, and cloves. They are again returned to the oven, which is heated to a less degree than at first; the operation is thrice repeated.

The flattened dried apples called *beaufins* (or vulgarly *biffins*), so abundant in the London shops, are prepared in Norfolk from a variety of apple called the Norfolk Beaufin; it has a thick skin, which resists, without bursting, the heavy pressure to which the apples are subjected in the oven during the slow and lengthened process of drying.

With regard to walnuts and other nuts, the only precaution that is necessary to take for their preservation is to maintain the air in which they are placed in a constant state of moisture. Burying in the earth, placing in a damp cellar, mixing with damp sand, and many other such plans, have been recommended; but they are all objectionable, either because they keep the fruit too moist, or do not offer any impediment to its becoming mouldy. We believe the best of all plans is to pack them in glazed earthen jars, throwing a small quantity of salt on the last layer before the jar is closed. Unripe gooseberries are kept for making tarts in winter in bottles or jars, filled up with perfectly dry sand, sawdust, bran, or the like, closely corked and sealed, after a gentle heat has been applied to expel moisture as much as possible, and placed in a moderate and equable temperature, which is sometimes accomplished by burying them to some depth in earth. Many of the finest kinds of fruit undergo such speedy decomposition that some of the most highly esteemed in the countries which produce them have on this account never become articles of commerce, and some of the most delicious grown in this country can only be enjoyed at the season of ripening, except in a state of jam or preserve.

FRUS'TUM, a portion cut off from any solid figure by a plane parallel with the base, except as to the frustum of a spheroid, which may be the part intercepted between two such planes, a sort of slice out of the middle of the figure. The term is most frequently applied in the case of the cone and conoidal surfaces of revolution. By frustum of a cone is meant any part cut off from a cone which does not contain the vertex. This distinction is drawn because any part of a cone which contains the vertex is another cone.

FRY, MRS. ELIZABETH, deservedly distinguished among the benefactors of mankind, was born 21st May, 1780. She was the third daughter of John Gurney, Esq., of Earlham, in the county of Norfolk, and a descendant, on the maternal side, of Robert Barclay, the well-known apologist of the Quakers. Through the instrumentality of Mr. William Savery, an American Friend who had come to England to pay a religious visit, she became impressed with the supreme importance of religion, and forthwith resolved to commence those manifold labours of philanthropy to which her future life was devoted. On her marriage with Mr. Fry in 1800 her residence became fixed in the neighbourhood of London, where she was ever on the watch for opportunities for relieving the destitute.

In 1813 she paid her first visit to Newgate, where a few years later she commenced her memorable labours. Under her auspices the association for the improvement of the female prisoners was formed in 1817. Prior to the establishment of this society their state was such as almost to baffle description. Without discipline, without employment, a prey to the worst impulses, these poor outcasts appeared sunk to the lowest depths of vice and ferocity. Mrs. Fry ventured among them alone; her gentle yet dignified demeanour, her kindly yet powerful admonitions, subdued their turbulence; and in a brief space of time order, industry, and cleanliness took the place of disorder, idleness, and filth. A sentence from her journal shows the spirit which animated her:—"I don't remember ever being at any time with one who was not extremely disgusting but I felt a sort of love for them, and I do hope I would sacrifice my life for the good of mankind."

This wonderful change attracted attention both in and out of Parliament, and in 1818 Mrs. Fry was invited to give evidence before a committee of the House of Commons on the subject of prison discipline. Through her influence arrangements similar to those adopted in Newgate were subsequently introduced into all the metropolitan gaols; and in conjunction with her brother, Joseph John Gurney, she personally inspected the prisons, lunatic asylums, and other kindred institutions in the United Kingdom, and afterwards those in the most influential continental nations. In the prosecution of these labours she had frequent interviews with many of the sovereigns of Europe.

The energies of this remarkable woman were devoted to a great variety of other objects equally noble and beneficent. She pleaded earnestly and unceasingly, and with the happiest results, for the persecuted, the ignorant, and the wretched of every grade, and has left behind her a splendid monument of grateful remembrance in the hearts of the British nation. She died in 1845, leaving a family of five sons and five daughters: two of the last-mentioned published a memoir of her life in 1857. See also an excellent biography of her in the Eminent Women series by Mrs. E. R. Pitman (London, 1881).

FU'CA, a strait of North America, in Oregon territory, leading into the Gulf of Georgia from the Pacific, south of Vancouver Island. It contains several islands, one of which, San Juan, was the subject of dispute in 1859, as it was claimed both by the English and United States governments. The question was submitted to the Emperor of Germany as arbitrator in 1872, and he decided in favour of the United States, determining that the boundary line should run through the Strait of Haro, west of San Juan.

FUCA'CEÆ is a group of seaweeds. [See ALGÆ.] They may be roughly described as seaweeds of an olive-brown or blackish-green colour. The thallus differs very much; sometimes it consists of a cup with a short stalk (*Himanthalia lorea*), or of a ribbon branching in a forked manner (Fucus); sometimes it possesses cylindrical as well flattened portions, and often reaches such a degree of differentiation of parts as to be comparable to flowering plants, putting on an appearance of roots, stems, leaves, and fruit, as in the gulf-weed (Sargassum).

The thallus is composed of a central portion of elongated cells, and an external layer of small closely-crowded cells. Several of the Fucaceæ have portions of the thallus hollowed out into air cavities which act as floats; in the gulf-weed these air-vessels are like fruits.

Reproduction takes place by the union of antheridia with oögonia, which are formed in hollows in the thickness of the cortical layers; these hollows are called conceptacles, and they contain only oögonia, or only antheridia, or both. Some species have both kinds of conceptacles on the same plant, while others have them on different plants. Fertilization takes place outside the conceptacles. The genera found in British seas are the following:—*Himanthalia*, in which the fertile segments resemble fronds, being long and repeatedly forked, and the thallus or frond is round, small, and cup-shaped; *Fucus*, in which the root-like structure is a round or flattened disc, and the conceptacles

are large, and filled with mucus; *Pycnophycus*, in which the root-like structure is composed of branching fibres, and the conceptacles are cellular; *Cystosira*, in which the air vessels are in the branches, and the conceptacles are small; *Halidrys*, in which the air-vessels are long and pod shaped.

FU'CAGE, in the middle age, a sort of hearth-money paid for every chimney in a house. Thus the Black Prince, in the reign of Edward III., levied 12*d.* for every fire on the subjects of the Duke of Aquitaine.

FUCHS'IA (usually pronounced Fusch'ia), a genus of plants belonging to the order ONAGRARIEÆ. This genus was named after the German botanist Fuchs in 1542. *Fuchsia microphylla* (small-leaved fuchsia) is a native of the volcanic mountain Jorullo in Mexico. It has a scarlet calyx, with deep-red petals, and blossoms from June to September. It was first described by Humboldt, Bonpland, and Kunth, in their work on American plants, and was first introduced into England in 1828. It is now one of the most commonly cultivated of the species in our gardens. *Fuchsia coccinea* (scarlet fuchsia) is a native of Chili, in marshy districts, and is found as far south as the Strait of Magellan. It is one of the species earliest introduced into the gardens of Great Britain, and was first described by Aiton, in the "Hortus Kewensis." It has a scarlet calyx, with purple petals. In its native countries the wood is used for obtaining a black colouring matter, and the leaves and young branches are used as medicine. It grows and blossoms in the open air in summer, but requires protection in the winter. *Fuchsia arborescens* (arborescent fuchsia) is a native of Mexico, and has been introduced into this country since 1824. It is a larger plant than most of the species, not unfrequently attaining a height of 15 feet. *Fuchsia gracilis* (slender fuchsia) was first described by Lindley, and has been grown in this country since 1823. The flowers have a scarlet calyx and purple petals. There are altogether fifty species, natives of Mexico and South America, especially in the west; a few are also found in New Zealand. The characteristics which separate it from Œnothera and other genera are the following:—The calyx limb is four-lobed, and produced beyond the ovary; there are four sessile petals, eight stamens, a four-celled ovary with several ovules; the fruit is a pulpy berry.

No flowers of recent introduction into Great Britain have become so popular as fuchsias. New varieties and hybrids are being continually introduced, and the plant may now be seen of almost every colour and size.

FUCI'NO or **CELA'NO, LAGO DI,** a lake of Italy in the province of Aquila, in the Central Apennines, 2181 feet above the sea. It has no natural outlet, and its sudden risings have at all times been a source of danger to the surrounding country. A magnificent tunnel, 3½ miles long, of which a distance of 1½ mile had to be pierced through the solid rock, was constructed in the reign of the Emperor Claudius to carry off the surplus water; 30,000 men are said to have been employed during eleven years in this great work, but though many efforts were made to keep it open, it gradually became choked up. In modern times a private company commenced the clearance of the old channel and completed the operation in 1862. The result was the reclamation of some 36,000 acres of good corn land and the reduction of the circumference of the lake from 37 to about 12 miles. In severe winters the lake is frozen over.

FU'CUS. See FUCACEÆ.

FU'CUSINE ($C_{15}H_{12}N_2O_3$), an organic base isomeric with furfurine, discovered by Stenhouse and prepared from fucusamide obtained from fucusol, an oily body rising from the distillation of fucus with dilute sulphuric acid.

FUE'GO, TIERRA DEL. See TIERRA DEL FUEGO.

FUEL. Any combustible substance may be called fuel, but the term is generally limited to those materials usually employed for the generation of heat. Although some form of fuel was used by man for domestic purposes from the early ages of civilization, the importance of it as applied to the arts and manufactures is comparatively recent. It first became absolutely necessary in the smelting of ores, and in making of bricks, pottery, and glass. The introduction of the steam-engine, however, has given an enormous impetus to the use of fuel, and it may now be said that the economy of fuel is one of the most important items, not only in the manufacture, but also in the carriage of all our produce almost without exception. The principal fuels are wood, peat, and coal: wood is that originally used by man; peat is little used in this country; coal is the only important fuel to us. All are of vegetable origin, and all contain nitrogen, but they differ widely in composition and in heating power. The following may be taken as a fair average comparison of these three fuels in the air-dry state:—

	Wood.	Peat.	Coal.
Carbon,	40·36	46·1	75·80
Hydrogen,	4·91	4·6	5·22
Oxygen,	32·66	23·6	11·98
Nitrogen,	·90	1·0	1·93
Sulphur,	—	—	·90
Ash,	1·17	1·5	5·17
Water,	20·00	23·2	
	100·00	100·0	100·00
Yielding fixed carbon,	23·00	31·5	65·50

Wood differs much in its heating power on account of the variable amount of water it contains, and this must be evaporated at the expense of the fuel; when thoroughly air-dry it contains about 20 per cent. of water. It can be perfectly dried in a kiln, and if still further heated without access of air it is converted into fixed carbon or charcoal. This is almost pure carbon, and has a much higher calorific power than the wood employed; the same applies also to peat and coal, from which the yield of carbon is given also in the above table, as charcoal and coke. Wood charcoal is used a good deal on the Continent for domestic purposes in heating apartments and cooking; and in this country it is employed in some important metallurgical operations, as in the manufacture of steel by cementation and the production of pure cast iron. At one time the forests of Sussex and Kent were the sole seat of the iron industry using the charcoal process; the wood has now, however, become too scarce and valuable. Like all the fixed carbons, it gives no visible smoke, but the fumes being thus unnoticed have often proved fatal.

Peat.—There are two varieties of peat, both derived from decayed mosses, &c., in what are known as peat bogs: the upper spongy portion is called turf; the lower, which is harder, denser, and blacker, having been subjected to more pressure, is called peat. The air-dry turf contains double the quantity of water, and being very porous will absorb its own weight. It is therefore, even when dry, a poor fuel. In the bog both will contain from 80 to 90 per cent. of water. Enormous bogs exist in different parts of Great Britain and Ireland, and although large sums of money have been spent in experiments, little has yet been done to convert them into available fuel. Another difficulty with peat is the fact that the larger the quantity collected the more expensive becomes the carriage to a given point, from the largely extended area of collection.

Coal.—This, the only really important fuel to our country, and on which its prosperity so much depends, has already been fully described. [See COAL.] The varieties are almost indefinite, but from a fuel point of view there are two main

varieties—anthracite and bituminous coal; we leave out of account lignite, which is not used in this country, and shale, which is employed only for the production of paraffin oil. Anthracite is distinguished by containing mostly carbon, and it is therefore a smokeless coal. It does not burn readily, and requires a very strong draught. It develops a high temperature, and is principally used for smelting purposes.

Bituminous coals contain much bituminous matter, and yield rich gases and tar. Those which swell up and leave a bulky carbon are called *caking* coals; those which retain their form or split up are called *free-burning* coals; and those which give a rich luminous gas are called *cannel* coals. The following represents the average composition of these varieties:—

	Anthracite.	Bituminous.		
		Caking.	Free-burning.	Cannel.
Carbon, . . .	92·56	87·68	78·57	84·07
Hydrogen, . .	3·33	4·89	5·29	5·71
Oxygen, . . .	2·53	3·39	12·88	7·82
Nitrogen, . .	—	1·31	1·84	—
Sulphur, . .	—	0·09	0·39	—
Ash, ...	1·58	2·64	1·03	2·40
	100·00	100·00	100·00	100·00
Yield of fixed carbon, . .	94·00	79·80	57·20	59·00

The carbon and the hydrogen are the only two elements the combustion of which affords the heat, so that the calorific value of a fuel depends on the quantity of carbon and hydrogen it contains. The amount of heat generated by the combustion of hydrogen is 4·265 times as great as that obtained from an equal weight of carbon. The presence of oxygen, however, reduces the calorific power of the fuel, as it is already combined either with carbon or hydrogen, and therefore renders a certain proportion of these elements inefficient for heating purposes, and this in estimating the value of the fuel must be allowed for.

The following table shows the relative calorific power of carbon and hydrogen, and the three different fuels in ordinary use:—

	Relative Calorific Power.	Weight of water heated from freezing to boiling.	Weight of water at 100°C. converted into steam.
Hydrogen, . .	4·265	344·62	62·658
Carbon, . . .	1·000	80·80	14·691
Coal, ...	1·017	82·20	14·983
Peat, air-dry, .	0·526	42·50	7·727
Wood, " .	0·439	35·47	6·449

Small coal, called slack or dross, is largely burned into coke and used for furnace purposes. It is also compressed or cemented into bricks, and used under the name of patent fuel; a great variety of mucilaginous substances have been employed for this purpose. In some cases the cemented bricks are recarbonized, or coked, to make a smokeless fuel. Coal gas is daily more and more employed as a fuel for domestic purposes, and the introduction of the electric light may make this the most important of its applications. Its employment as the fuel of the gas engine bids fair to revolutionize our motive power. Siemens' regenerative gas furnace has led to the employment of gas as a fuel in many of our largest manufactures, giving as it does a higher and more regular heat than has yet been attained in direct firing by coal. Gas producers of simpler kinds are now also used in many large works in preference to firing with coals direct. [See GAS and FURNACE.] The freedom from smoke and soot, the great heat attained, and the economy of this fuel specially commend it, and there is little doubt that it will soon become the fuel most in use, especially as this method also allows of the separation of the ammonia produced, which in many cases is equal to the value of the fuel.

FUEN'TES D'ONOR'E (meaning "the fountains of honour"), a small town of Spain, near Ciudad Rodrigo, memorable for a sanguinary battle fought in 1811 between the British troops under Lord Wellington, with 35,000 men, and the French under Marshal Massena, with 51,000; in which the former were victorious, the French having sustained a loss, in killed and wounded, of 5000 men, and the British 2000. This battle terminated the French invasion of Portugal.

FUER'O, a franchise or charter of liberties written or unwritten. The word is Spanish, derived from the Roman *forum* (justice place) by a very natural change of meaning. These fueros are a source of great trouble to Spain, being relics of the many different states into which the country has at times been divided. They are most jealously preserved, and half the risings in that unhappy country are due to some meddling with the fuero of some town or province. As each fuero or body of customs differs, common legislation is terribly hampered. As for the fueros of the Basque Provinces and Spanish Navarre, they amount to practical independence, and are the most interesting of all similar bodies of law, since they preserve almost unchanged the Gothic rule of the ancient Visigoths. Those of Navarre were formulated and written down, to avoid a repetition of the constant disputes, in 1236, forming the charter or Cartulario del Rey Tibaldo. Among the privileges of the fuero of Biscay is the curious one that every man of free birth is to be considered noble, and that Biscayans are exempted from the conscription. Evidently we have here a relic of the ancient times when one of the Teutonic tribes could call itself Frank, for all its members were free men, and no man the lord of another.

FUG'GER, a German family, originally of Graben, near Augsburg, that, starting as simple weavers about 1300, amassed great wealth in the fifteenth and sixteenth centuries by commerce. The Fuggers were of immense service to the Emperor Maximilian and Pope Julius II. For these services, among other rewards, they secured the county of Kirchberg and the lordship of Weissenhorn. Besides conducting this princely banking business they traded in everything—from Dürer's paintings to the working of mines and development of vast estates. The Fuggers were created counts in 1530, with princely rights, and even the power to coin money by Charles V., to whom they had lent large sums of money, and it is said they lighted a fire of cinnamon wood with the securities on the occasion of a visit from him. Count Antony Fugger left 6,000,000 crowns in gold at his death, not counting money invested in securities, lands, or jewels. They also supplied Philip II. with money, and contracted for the quicksilver mines of Almaden, in Spain. The family became divided into branches, one of which obtained the rank of princes of the German empire, under the title of Fugger Babenhausen, near Ulm. The family still exists, and their domains are partly in Bavaria and partly in Würtemberg. The Fugger family, in the sixteenth century, made a liberal use of their wealth in founding charitable institutions, such as the one still called Fuggerei, in Augsburg, in promoting learning, collecting MSS., and forming valuable libraries. Several members of the family were themselves men of learning and literature.

FUGITIVE SLAVE LAW. The constitution of the United States having recognized slavery as service, necessarily contained several provisions for its enforcement. By

article 4, section 2, of that document, it is declared that persons held to service or labour in one state, and escaping into another, shall be delivered up, on claim of the party to whom such service or labour may be due. An Act passed in 1793 rendered this provision more stringent and compulsory; and it was made even still more so by the Fugitive Slave Law, which was passed in 1850, after encountering very much opposition in both Congress and the Senate. It provided that when any fugitive escaped into another state, the owner or his agent might pursue and arrest him. He was then to be taken before a commissioner or judge, whose duty it was to hear and determine the complaint in a summary manner. If he was satisfied of the validity of the claim and the identity of the slave, it was his duty to grant the claimant a certificate, empowering him to remove the fugitive to the place from which he fled. The testimony of the fugitive himself was not admissible. Any assistance rendered to a fugitive to enable him to escape from the claimant, or any obstruction offered to his arrest, was penal, and also subjected the party to damages at the suit of the owner. All citizens of the United States were required, when called upon, to render the officers employed to capture the fugitive personal assistance in the performance of their duty, whether the proceeding took place in a free state or not—the principle of the measure being that the constitution and laws of the United States secured the right to reclaim fugitive slaves against state legislation. As may be naturally supposed, the measure was detested by the abolitionist party in the North, and its provisions often openly set at nought. They regarded it as an undoubted infringement of the laws of the free states, and as inhuman as it was unconstitutional; for it deprived the negroes (whom they held to be fellow-citizens) of the right of trial by jury; and there can be no doubt that the animosity which it created and perpetuated was one of the chief causes of the American civil war. The obnoxious measure was finally repealed on 28th June, 1864.

FU'GUE, the highest *form* in music of the strict style. Nothing probably in music is so ill-understood by those not themselves professors of the art as fugue. The simplest piece of IMITATION is dignified by this noble name; and even composers of these latter days if they open a fugal passage with the recognized exposition, and follow it up with a brief dominant pedal passage, frequently consider themselves entitled to call such a slight piece of work a fugue. Not that a fugue need be a long composition. The exquisitely beautiful pianoforte fugues of Bach are not longer than a sketch by Schubert, or a "song without words" by Mendelssohn. But they contain a certain and very definite form, the flower and outcome of centuries of what we now call formal music; and the task before us in this article is to elucidate that form in a sufficiently ample way so that the reader can not only see what a fugue is, but can ever afterwards find beauty and consummate skill in what to those not yet possessed of the key may have seemed less attractive than the simpler and more ordinary forms of composition.

A fugue, then, is a piece of music developed from a given melody, which is now technically called the *subject* (or *theme*, or *dux*, or *antecedent* in older writers). This subject is treated by imitation in a special manner. It must be answered at the fifth or at the octave by another voice from that which introduced it. The *answer* (also called *comes* and *consequent* by older writers) is a close imitation of the subject. Usually the answer is accompanied by the part which led off, which continues with a *counter subject*, and also in most cases when the answer ends the two parts continue for a bar or two in some graceful passage of connection, delaying and preparing at the same time the entry of the subject for the second time; this is the *codetta*. Or the subject may end with a codetta the better to fit on to the answer. In skilfully written fugues the counter subject and codetta are themselves imitated throughout the piece, and serve to diversify the constant imitation of the subject. Later in the fugue must occur a *stretto*, that is to say, a passage where subject and answer overlap each other, or may be said to tread on one another's heels. This is a special beauty in fugue, and the greater variety of strettos a composer can produce the more interesting his fugue. The word *fuga* is merely the Latin for flight, and it is here that the mimic chase of subject and answer culminates in the one catching up the other. All the parts should enter into the chief stretto, and the grand way in which in a fugue of Bach's or Handel's voice after voice or part after part comes crashing in with the well-known melody, crowding one after the other perhaps at only a bar's length, is certainly one of the most majestic of all musical effects. A fine stretto has also this remarkable peculiarity, that it is as fresh the hundredth time of hearing as the first. The element of surprise in it is not like the clever weaving of a plot in a novel, where when once the secret is out the surprise cannot be renewed; it is rather like one of Turner's daring freaks of colour (as the "Burial of Wilkie" or the "Temeraire") or like one of Shakspeare's highest dramatic contrasts (as the knocking at the gate in "Macbeth"); it is so founded in the very nature of the mind as to be perennially active. The more one contemplates these things, so carefully worked up as at first to seem to happen almost by accident (*ars celare artem*), the more one admires them, and this without ever any diminution of the shock of surprise felt at the first acquaintance with them. So is it with a truly grand stretto, and in more or less degree with a truly grand fugue as a whole. And this is the cause why the musician never tires of playing the fugues of Bach, or the public of hearing those of Handel. Mendelssohn never let a day pass without a fugue of Bach's, the book lay always open on his pianoforte. The audiences at the Handel festival (where only the choruses—practically all fugues—can be properly heard, the solo voices being far more effective in a smaller space) assemble in an almost countless multitude every three years, and the singers come in their thousands, to enjoy the noble works of fugue, though not one in a hundred possibly could explain what a fugue is.

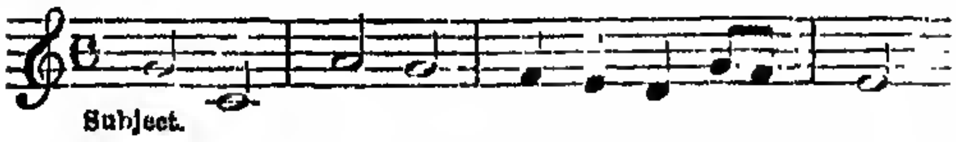
Beyond these elements there are usually the *pedals* or organ points; always a dominant pedal, and nearly always a tonic pedal to close with. See PEDAL.

Each of the parts of fugue given above requires a few brief remarks in elucidation of its nature.

The *subject* should not be long, it is usually either four or eight bars long. If it were longer the piece would drag, if it were shorter it would not be clearly marked in character, and this latter qualification is essential. It must be of moderate compass and definitely in one key, and end on an accented note of the bar, preferably the first. It may begin at any point of the bar. It must be suitable for stretto, that is, it must bear an imitation upon itself at the fifth or the octave, the imitation beginning during the subject, and not as in ordinary imitation after its close. It follows therefore that the stretto is always the first part of a fugue to be written. If the subject can be used in more than one way for stretto it is preferable.

The *answer* is the subject repeated at the octave (fugue on the octave) or at the fifth or dominant (fugue on the fifth) the latter being by far the more usual form. Broadly speaking, the answer (by which is always meant the answer at the fifth, unless it is specially named that the fugue is on the octave) is the subject taken in the key of the dominant. But as at the same time the piece must not really change its key, answers divide themselves into those which can and those which cannot exactly follow the subject without causing a change of key. These are *real* and *tonal* answers respectively; and when to use a real

and when a tonal answer is one of the most puzzling niceties of fugue. An example will make this clear. We give a subject, its real answer (*i.e.* the subject imitated strictly at the fifth) and its tonal answer, where the subject is modified.



Subject.

Real Answer.

Tonal Answer.

It is at once felt that the tonal answer is here the true one, the real answer, beginning as it does on the dominant itself and ending on the third of the dominant, is really in the key of the dominant. It would carry us from the key of C to that of G. In these and similar cases the rule is to answer dominant by tonic (as here, G is answered by C), the third of the dominant by the third of the tonic, and the sixth of the dominant by the sixth of the tonic, and (as here, in the third note) *vice versâ*. To give all the rules on the subject would be of course beyond the scope of this article, but the general principle governing them may be stated. This is to regard the scale as made up of two parts—the region of the tonic, 1 2 3 4 5, and the region of the dominant, 5 6 7 8. Evidently the latter, with only four notes to correspond to the five of the former, frequently needs that a melody repeated in it should be altered slightly; thus, for instance, the phrase 1 2 3 4 5 would be tonally answered by 5 5 6 7 8. After a tonal alteration of the subject the strict imitation must be at once returned to, and tonal alterations are always made when approaching or quitting the dominant or the tonic.

The *exposition* of a fugue is the appearance of subject and answer alternately through the parts. Thus, taking a four-part fugue for voices, the subject may begin in the bass, followed by the answer in the tenor; then perhaps occurs a codotta of two bars (or not, as the case may be), and then the subject is heard again in the alto, followed by the answer in the treble, the counter subject heard first against the answer continuing to accompany the theme whether as answer or subject. This order may be varied in any way (as for instance tenor, alto, treble, bass, &c.), and the counter subject sometimes does not appear at every repetition. In some few fugues there is no counter subject at all.

After the exposition usually occurs an *episode*, and indeed each principal group of a fugue is separated from the succeeding group by such an episode. This should not be an entirely fresh figure, but one growing out of the matter of the fugue, such as an amplification of one of the phrases by sequence or by variation, by ingenious imitation (inverted, or the like), &c. If it is in the stretto that the skill of the composer is most tried, it is in the episodes that his fancy and ingenuity are brought out.

The exposition and its consequent episode are succeeded usually by a *counter exposition*, where the order and materials of the exposition are reversed, the answer now leading in the dominant and being replied to by the subject in the tonic. Of course this part of the fugue is not so formal as the opening, or variety would be lacking: the codetta may be freely used, the whole of the parts perhaps do not join, the accompaniment (if there is one) is varied, &c. A counter exposition is followed by another and perhaps more extended episode.

The *stretto* should now occur. Probably the counter exposition or the episodical matter following it will have contained one of the less important strettos, but the chief stretto must be reserved as the culminating point. It is very usual to build it up on a dominant pedal, and to have a brief partial repetition of it on a tonic pedal to close. Or a dominant pedal may be used to awake interest by delaying the appearance of the stretto, which then crushes in at the end. As to the *pedals* the usual rules must of course be observed.

Thus the sketch fugue which has been drawn up would consist of exposition, episode, counter exposition, stretto, and dominant pedal, tonic pedal, and close. This is necessarily a very simple account, but it is manifest that every conceivable device of counterpoint and imitation may be freely introduced, provided the fugue is not over-crowded. The fugue should contain interesting changes of key, but never modulate to keys at all remoto. Full cadences are never allowed except the full close at the termination of the piece. The greatest masters are always the simplest fugue writers. They rarely have all the parts going at once, and the writing of each part is varied so that the ear can follow all the several careers at once without confusion. If a part is about to enunciate the subject it is always allowed to rest a short time, so that the freshness of the attack may be intensified.

In conclusion, to indolent people who will not take the trouble to understand a musical form fugue is dry; such persons are content with a ballad sung to the simplest accompaniment, that is to say, they grasp only emotional music. But he who has mastered even such an incomplete account as the present article, and then listens to a good fugue, tastes the pleasure of intellectual music; and no one who has tasted once of that tree ever tires of its fruit. A bad fugue is probably as dull a thing as could be found, but a really good fugue yields to a competent performer or listener one of the highest, purest, and most intellectual pleasures which it is the lot of man to enjoy. A fugue with two principal subjects is called a *double fugue;* and in a fugue of this sort each subject must have its own elaboration, its own stretto, &c., and both must work together at certain points. When a chorale or hymn-tune forms part of a fugue (especially if it combines in the exposition with the subject and answer) we have the fine form of the *choral fugue.*

FUH-CHOW. See Foo-choo-foo.

FUH-KEEN, FU-KIAN, or **FO-KIEN** (meaning "consummation of happiness"), one of the eastern maritime provinces of China. It lies between lat. 24° and 28° N., and lon. 116° and 121° E. It is bounded on the S.E. by the China Sea, and on other sides by the provinces Che-kiang, Kiang-si, and Quang-tung. The surface is mountainous, and produces the finest black tea, the best camphor, as well as tobacco, sugar, iron, indigo, and alum. The principal fruits are the orange, lemon, and mulberry. On the coast are the ports of Foo-choo-foo (the capital) and Amoy, which were opened by the treaty of Nankin, 29th August, 1842. The island of Formosa and the Pang-hoo group are comprised in this province. The area is 53,500 square miles, and the population is said to be 26,000,000.

FULC or **FULK**, a favourite name with the counts of Anjou, whence descended our Henry II. of England.

Fulc the Red (Fulc I.) was the son of the first Count of Anjou and grandson of Tortulf the Forester, a Breton freebooter, originally hardly more than a woodman (whence his sobriquet). To Tortulf's lands, won by hard fighting from the Danes, succeeded his son Ingelger, whom Charles the Bald of France named Count of Anjou. Fulc the Red deserted the party of the Karling kings for that of the Capets, the great dukes of France, and reaped his reward in large accessions of Angevin territory (888). He may be regarded as the true founder of Angevin greatness.

Fulc II. (938) was in heart a priest, though he was the son of so wily a statesman. He even took the title of Canon of Tours. Under his peaceful rule Anjou prospered

greatly, and he earned the honourable surname of Fulc the Good.

FULC THE BLACK (Fulc III.) was the greatest of his name. He was the grandson of Fulc the Good. He found his county on his accession in 987 the least important of the provinces of France, and left it at his death in 1040, though not the largest, certainly the most powerful. He was the most consummate captain of his time, and the equal of most in sagacity. One by one all his foes went down. The markedly superior power in intellect which most of our Angevin kings (the so-called Plantagenets) enjoyed, seems to come from this Fulc the Black, their ancestor. With it also came the irreligion, the cruelty, and the lust which disgrace almost all of them. Fulc III. heard of a courtier who was poisoning the king's mind against him. He sent twelve knights to reconquer the king's friendship by murdering the backbiter in his presence. With all this he was superstitious (another trait of the Angevin kings of England), and as the year 1000 drew near he became possessed with the prevalent fear that the world was then to end. He therefore made a pilgrimage to Jerusalem, and was there scourged barefoot through the streets. His son Geoffrey continued the career of conquest, but was checked to the northwards by the sudden rise to power of the dukes of Normandy.

FULC RECHIN (Fulc IV.), grandson of Fulc the Black, is chiefly noteworthy for the faithlessness of his wife Bertrada, whom the king (Philip I.) ran away with, and absolutely married, locking up his lawful queen meanwhile. Pope Urban excommunicated him, and a failure in the king's health assisted the papal thunder in restoring Bertrada to Anjou. Fulc was a feeble prince, but his son, FULC OF JERUSALEM (Fulc V.), was as powerful as his father had been weak. He it was who stirred up the Norman troubles of our kings after the Conquest. He was the one enemy whom Henry I. of England really feared. To gain him over Henry married his daughter Matilda (the Empress Maud), after the death of her first husband, the Emperor of Germany, to Fulc's son, Geoffrey the Handsome. In 1131 Fulc, who had gone to the Holy Land, was elected the successor of Baldwin II., and thus became the fourth king of Jerusalem. At his death in 1144 he left to his son Geoffrey the counties of Anjou and Touraine, to which by marriage with the heiress of England Geoffrey had added the duchy of Normandy and Maine, and a claim to the English crown. Henry, Geoffrey's son, by marriage with Eleanor of Poitou, added the seven provinces of the south, Poitou, Saintogne, Auvergne, Perigord, Limousin, Angoumois, Guienne; and was thus in 1153 ruler of far more of France than King Louis VII. This powerful prince landed in England in that year to challenge the crown, as grandson of Henry I., against Stephen, the reigning monarch. An arrangement was come to recognizing him as Stephen's heir; and the next year he succeeded to the English crown, the first of the Angevin kings of England. See ANJOU, COUNTS AND DUKES OF.

FUL'CRUM (from the Latin *fulcire*, to prop up, sustain), the fixed point about which a lever moves. The main point necessary in a fulcrum is that it shall be strong enough to bear the pressure upon it. When the power and the weight are pressing in the same direction, then the pressure on the fulcrum is their sum, and this is the case when the fulcrum lies between them (fig. 1). When both power and weight lie on the same side of the fulcrum, as in fig. 2 (where P acts upwards and W downwards), then

Fig. 1.

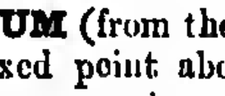
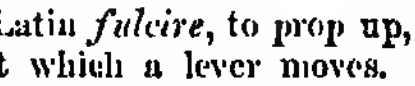


Fig. 2.



the pressure on the fulcrum is their difference. The difficulty of finding a sufficiently stable fulcrum is often that which prevents a given leverage from being possible. Thus said Archimedes—"Give me a fulcrum and I will move the world." See LEVER.

FULDA, a town of Prussia, in the province of Hesse-Nassau, about 60 miles N.E. from Frankfort-on-the-Main. It is built on the banks of the Fulda, which is crossed by a handsome stone bridge. Fulda is a pretty town, with eight suburbs outside its walls. The walls, which are decayed, have seven gates. Its population is 11,000. It contains a market-place, two squares, an electoral palace and grounds, a cathedral—where St. Boniface or Winfried, a zealous English missionary, is buried, having been slain by the heathen Frisians near Dockum in West Friesland in 751—numerous churches, a Roman Catholic lyceum, a Protestant high-school, a chapter seminary, a school in which forest economy is taught, and another for educating teachers, an hospital, public library, &c. The manufactures consist of linens, woollens, stockings, saltpetre, leather, tobacco, artificial flowers, and musical instruments, for which it is noted. Most of the inhabitants are Roman Catholics.

FUL'GORA. See LANTERN-FLY.

FUL'HAM, a suburb of London, in the county of Middlesex, 4 miles W.S.W. from Hyde Park Corner, on the north bank of the Thames, which is here crossed by a bridge connecting it with Putney. Fulham forms part of the borough of Chelsea. Though irregularly built, it contains some handsome houses. The palace is the summer residence of the bishops of London. The first bishop who is certainly known to have made it his residence is Robert Seal or de Sigillo, in 1141. The palace is a quadrangular brick building; the grounds include nearly 40 acres. A private chapel, with a very handsome interior, was erected near the building by Bishop Tait in 1867. The parish contains an orphanage and a reformatory, an industrial home, and other benevolent institutions. According to some authorities Fulham derives its name from a Saxon word meaning "habitation of birds;" according to other authorities "a dirty place" is the more correct interpretation. The chief event in its history was the encampment of the trainbands of London, under the Earl of Essex, during the Civil War, when the Thames was crossed by a bridge of boats.

FULIGULI'NÆ is a subfamily of the great family Anatidæ, belonging to the order ANSERES. The Fuligulinæ are the sea ducks, the freshwater ducks forming the subfamily Anatinæ. See DUCKS.

The sea ducks frequent the sea principally, but many of them are to be found in fresh-water lakes and rivers where the water is deep. The plumage is very close and thick in comparison with that of the true ducks (Anatinæ), and the covering of the female differs much in hue from that of the male, which when adult undergoes but little change in its dress from the difference of season. The young resemble the female in their feathered garb, and do not assume the adult plumage till the second or third year. Moulting takes place twice a year without change of colour. In the male the capsule of the trachea is large.

The sea ducks are not good walkers, on account of the backward position of their feet, but they run, or rather shuffle along rapidly, though awkwardly. They swim remarkably well, though low in the water, and excel in diving, whether for amusement, safety, or food, which last consists of insects, molluscs, the fry of fish, and marine or other aquatic vegetables. They take wing unwillingly as a security from danger, relying more confidently on their powers of diving and swimming as the means of escape than on those of flight. Though they are often strong, steady, rapid, and enduring in their passage through the air, they generally fly low, laboriously, and with a whistling sound. This subfamily may be considered to be monogamous, and the nest is frequently made near the fresh water; the female alone incubating, and in some species stripping the

down from her breast as a covering for the eggs, which are numerous.

Geographical Distribution.—The north may be considered the great hive of the Fuligulinæ, though some of the forms are spread over the greater part of the globe. Large flocks are seen to migrate periodically, keeping for the most part the line of the sea-coast, and flying and feeding generally by night, though often, especially in hazy or blowy weather, by day.

The genera included in this subfamily are Somateria (EIDER-DUCK), Œdemia (SCOTER), Fuligula (POCHARD, &c.), Clangula (GOLDEN EYE, &c.), Harelda (LONG-TAILED DUCK.

FULL CLOSE, or Full Cadence, in music, the tonic harmony preceded by the dominant harmony; almost always used, as settling the key firmly, at the close of a piece. See CADENCE.

FULL SCORE, see SCORE; Full Organ, see ORGAN; Full Orchestra, see ORCHESTRA; Full Anthem, see ANTHEM; Full Service, see SERVICE. Terms in music. In general "full," as in Full Choir, means, when used in musical compositions, that the whole force at command is to be used. Full Choir would bring on all the voices after a passage by Half Choir. It does not mean that the passage is to be loud, unless the usual *ff* mark is appended.

FULLER, MARGARET, a distinguished American authoress, was born at Cambridgeport, near Boston, on 23rd May, 1810. Her full name was Sarah Margaret Fuller, but she is invariably known by the second name only. At the age of six she was already immersed in the studies of Latin and of English grammar. Her father, a lawyer and politician, demanded accuracy in everything. It is the mistaken case of the two Mills over again. Margaret grew up with half her life blunted and the other half inordinately sharpened, just as Stuart Mill did under the same treatment. Mill did later on somewhat recover from the folly of his father, Margaret Fuller remained undeveloped to the end of her days. She was exceedingly plain, except that she had fine hair and a graceful carriage of the head; but she was also exceedingly ambitious, and aimed at nothing less than leading society. The labours she underwent in her craving for knowledge are certainly extraordinary; but it is, to say the least, doubtful if knowledge in itself so much as the power knowledge would bring was her ruling aim.

This power soon came to her. Her teaching in schools at Groton and at Providence in 1836 and 1837 showed her to be certainly the leading woman in America. She ruled Boston (or at all events feminine Boston) with a masterful hand. These were the days of the Transcendental movement (1839), and Margaret plunged deep in that vague ocean. She became in 1840 editor of the *Dial* magazine, to which Emerson, Freeman Clarke, Theodore Parker, Bronson Alcott, and such really great minds contributed. It lasted four years; and a collection of original copies has long been one of the prizes of the bibliopole. It was republished in 1884 in response to a general demand. Margaret Fuller sympathized also with the socialistic phase of American society which led to the famous socialist community of Brook Farm, etherialized and satirized by Hawthorne in his immortal "Blithedale Romance." She frequently visited there. It is simply untrue to say, as many have said, that Zenobia in that famous little book is drawn from Margaret Fuller. Hawthorne was more inclined to smile at her pretensions than to treat them tragically. In his "American Note-Book" he complains of "a transcendental heifer belonging to Miss Margaret Fuller." He says—and it is impossible not to see that he is glancing at some one besides the heifer—"Miss Fuller's cow hooks the other cows, and has made herself ruler of the herd, and behaves in a very tyrannical manner. She is not an amiable cow, but she has a very intelligent face and seems to be of a reflective cast of character. I doubt not that she will soon perceive the expediency of being on good terms with the rest of her sisterhood."

In 1844 Mr. Greeley secured her services for the *New York Tribune*; and in the same year appeared the work by which she is best known, "Woman in the Nineteenth Century." Lecturing and conversing incessantly on ethical, classical, and educational topics, with her vast and undigested reading and her transcendental ideas, it is easy to see that though on the one hand Margaret Fuller was by her friends called "the Boston Corinne," she would be on the other a favourite butt for the wits and satirists. Mr. James Russell Lowell, in his "Fable for Critics," hits off the weaknesses of her character in a passage of satire worthy of Pope:—

"But here comes Miranda; Zeus, where shall I flee to?" &c.

Even her greatest friend, Harriet Martineau, speaks of her at this time as a "dreamy haughty pedant." But a change almost miraculous came over Margaret Fuller, sufficient to show that had she lived she would have become one of the truly great ones of the world. She came to England in 1846, and was well received by those who regarded her as their literary equal. Certainly she and Miss Martineau had once for all put an end to the feeling that women could not attack graver forms of literature than lyric poetry or the novel. She passed hence through France into Italy (Paris yielding her an acquaintanceship with Madame George Sand, of which we have a charming record), reaching Rome in 1847. She had met Mazzini in England, and warmly attached herself to him and to his cause. In Italy, in 1847, she married a young Italian nobleman, the Marchese d'Ossoli, an ardent friend of the yet unborn republic, but the marriage was at first kept secret. The Ossoli estate was in the hands of gentlemen attached to the pope's service, and would certainly have been confiscated if the marchese were known to have married a Protestant. A new government was hoped for by the friends of Mazzini, and did indeed arrive in 1848. For some reason Margaret's child, Angelo, born that year, was left in the country and her marriage still kept secret. When in April, 1849, the French invested the city, Margaret Fuller took charge of one of the hospitals. Her husband was in command on the walls, and she occasionally joined him there. The city having fallen she hastened to her child, and found him almost starved, as the nurse had neglected him, despairing of further payment. The marriage was now no longer concealed, and with good nursing the boy recovered. While living at Florence, the Marchesa d'Ossoli was hard at work on a book on modern Italy, two volumes of which she completed. The manuscript was, however, lost with her.

Having decided to return to America, on the 17th of May, 1850, they started on the voyage in a merchant vessel. The voyage was disastrous all through. The captain died of small-pox, and then Angelo took it, but recovered. They were within sight of the American coast when a violent storm sprang up and the ship struck upon a sand-bar. There was no effectual help to be had from shore, but it was possible to save them one by one on a plank which a stout sailor pushed behind. The captain's widow was saved in this way; but when it was Margaret's turn she would not stir—she would not leave D'Ossoli and Angelo. The ship's steward took the poor child in his arms, and promised to save him or die; but they were washed ashore quite dead. Margaret and D'Ossoli died together. The sailors were many of them able to reach the shore. This was on the 19th July, 1850. The sad fate of Madame d'Ossoli and her heroism in the defence of Rome lend a pathetic romance to her life. Her biographers, Emerson, James Freeman

Clarke, W. H. Channing, and Mrs. Ward Howe (the latter being the most recent, London, 1883) all show the devoted attachment and belief in her great future which this extraordinary woman was able to inspire, far beyond the actual permanent work she accomplished.

FULLER, THOMAS, D.D., the author of the quaint old favourite "History of the Worthies of England," was born at Aldwinkle in Northamptonshire in 1608. He was educated at Cambridge, and became rector of Broad Windsor in Devonshire. In 1639 appeared his "History of the Holy War," and in 1642 his amusing and instructive "Holy and Profane State." In 1641 he was appointed preacher to the Savoy in London, and the quaintness of his imagery, the sparkle of his wit, and his undoubted learning brought him large audiences. His book went through four editions during the Commonwealth, though Fuller was a king's man during the Civil War. His "Palestina" (1650), "Abel Redivivus" (1651), and his "Church History of Britain from the Birth of Christ to 1648" (1656), were favourites at the time, but are now little read. His greatest work appeared posthumously: those "Worthies" which still delight us, and remain as quaint and fresh as the day they were penned. At the Restoration Fuller was made doctor of divinity and chaplain to the king, besides receiving again his prebend of Salisbury. He died in 1661.

FULLER'S EARTH is a soft earthy substance, somewhat soapy in feeling, varying in colour from greenish-gray to brown. It differs from ordinary clays (which it somewhat resembles in appearance) by crumbling with water instead of becoming plastic. In composition it is a hydrated silicate of alumina, with small and varying amounts of lime, magnesia, soda, and iron oxide. The fuller's earth worked at the pits of Nutfield (near Reigate) contains 44 per cent. of silica, 11 per cent. of alumina, 10 per cent. of iron (a high percentage), 5 per cent. of lime, 2 per cent. of magnesia, and 5 per cent. of soda. Fuller's earth has been traced as a result of the decomposition of diabase and gabbro. In England it is found in the Jurassic and Cretaceous formations; in the former it attains such importance as to constitute a distinct member of the Lower Oolite in the western counties. Near Bath it attains a thickness of 150 feet, but dies out to the west, and is absent in the north.

Fuller's earth was formerly used extensively in dyeing, but it is now almost completely superseded by chemical preparations. The French and German terms for our fuller's earth are respectively *terre à foulon* and *walkerde*.

FULLING, the art or practice of scouring, cleansing, and thickening cloth, serges, and other stuffs in a mill, by which the material becomes more compact, firm, and durable. The usual method of fulling may be described thus:—A coloured piece of cloth is laid in the trough of a fulling mill. For a piece of 45 ells about 15 lbs. of soap is required, one-half of which is to be dissolved in two pails of hot water. The solution is poured gradually upon the cloth, in proportion as it is laid in the trough, without any fresh soap, and there fulled two hours more. After this the cloth is taken out and well wrung in order to squeeze out the dirt and grease. After the second fulling the rest of the soap is dissolved as in the former case, and cast four times on the cloth. The cloth is then to be taken out and well stretched every two hours. When sufficiently fulled, and brought to the proper quality and thickness, it is scoured in hot water, and kept in the trough until it is quite clean. For white cloths a considerably less quantity of soap, as well as of labour, is required.

The art of fulling was not unknown to the ancients. According to Pliny (vii. 56) it was invented by Nicias, a governor of Greece, during the Roman domination. Among the Romans the fullers scoured, washed, and fitted up clothes; and their art was considered of such importance that various laws were passed for regulating it.

FUL'MAR is the name given to a sea-bird belonging to the family Procellaridæ or Petrels. The fulmar (*Fulmarus glacialis*) is a British species, but is most abundant in the Arctic seas. In Britain its only nesting-places are the islands of St. Kilda and Skye. This bird bears a strong resemblance to the common gull (*Larus canus*) both in size and colour, except that its primaries are gray instead of black. The feet want the hinder toe. The tip of the upper mandible is strongly hooked, and the lower mandible is truncated at the apex. The nostrils are produced into a tubule, and lie on the dorsal surface of the upper mandible.

The fulmar never comes to the coast, except for the purpose of nesting, or when driven there by gales. Its flight is easy and buoyant. Besides the flesh and blubber of dead whales or seals, for penetrating whose thick skins their trenchant and hooked upper mandible is admirably formed, barnacles and other parasites which attach themselves to the whales, molluscs, &c., form their food. During the summer these birds are the constant attendants of the whale-fishers. The fulmar breeds on rocky coasts, selecting the ledges of lofty and inaccessible precipices for this purpose. It lays a single egg, either in a rude nest or in a depression in the turf clothing the ledge, and so numerous are the birds in some localities, that the whole face of the cliffs seems to be covered with them. The eggs are taken in great numbers by the inhabitants of the vicinity, who esteem them highly as an article of food. In St. Kilda from 18,000 to 20,000 young are said to be killed in one week in August, when alone, by the custom of the place, it is lawful to take them. Both the old and young birds when seized emit a quantity of clear amber-coloured oil, which is collected. The young birds also are very fat, and are boiled down in great quantities for the sake of the oil they furnish. The fulmar is shown in fig. 4, Plate II. ANSERES.

FUL'MINATING MERCURY, or **FULMINATE OF MERCURY**, is prepared by dissolving one part of mercury in twelve of nitric acid (specific gravity 1·36), and then adding eleven parts of alcohol (specific gravity ·850). It crystallizes in white needles, is soluble in ammonia, and when dry explodes violently by percussion or heat, or by contact with sulphuric acid. The preparation of fulminating mercury is attended with considerable danger, and ought not to be attempted by anyone unacquainted with chemical manipulation. Mixed with six times its weight of saltpetre it is used for priming percussion caps and detonators for gun-cotton and dynamite. The composition is $C_2N_2HgO_2$.

FUL'MINATING SILVER, or **FULMINATE OF SILVER** ($C_2N_2Ag_2O_2$), is made in the same way as the preceding. It is an exceedingly explosive substance, the slightest touch being sufficient to explode it when dry. Even when moist it goes off readily, if rubbed with a hard body. It explodes at once in chlorine. The greatest care is necessary in handling it, as friction even under water will explode it. The ignition is extremely rapid; gunpowder mixed with it is not ignited by the explosion. It crystallizes in small needles, and is only slightly soluble in water, but dissolves freely in ammonia.

FULMIN'IC ACID. This acid is known only in combination. The formula is $C_2N_2H_2O_2$. It forms a number of salts, all of which are more or less explosive. The mercury and silver fulminates are the best known. It also forms a great many double salts. Fulminate of copper is obtained in small green crystals, and is highly explosive. Fulminate of zinc is a white explosive salt. Fulminate of gold is a brown powder also highly explosive. It is polymeric with cyanic and cyanuric acids.

FULMINU'RIC or **ISOCYAN'URIC ACID** ($C_3N_3H_3O_3$) is isomeric with cyanuric acid. It forms salts called fulminurates. The salts of the alkalies are obtained by boiling an alkaline chloride with fulminating mercury.

The acid is crystalline, and soluble in water, alcohol, and ether. This acid and its salts are all explosive.

FULTON, ROBERT, the first to establish steam navigation on the American seas and rivers, was born in 1765 in Pennsylvania. His parents were emigrants from Ireland. In 1786 he embarked for England, and lived for some time by painting; but his taste leaned towards mechanical pursuits. He spent about two years in Devonshire, where he became acquainted with the Duke of Bridgewater, and projects for the improvement of canals then began to occupy the chief share of his attention. In 1794 he took out a patent for an inclined plane, which was intended to set aside the use of locks; he invented a machine to facilitate excavation, and wrote a work on canals, in which he first styled himself a civil engineer. He also invented a mill for sawing marble, and took out patents for spinning flax and making ropes. These projects failed to enrich him; and he went to Paris, where he studied languages, invented a submarine boat, projected a panorama, and made experiments in the Seine with small steamboats. After trying in vain to introduce his submarine boat into England, he went to America in 1806, and soon afterwards commenced the construction of a steam-vessel of considerable size, which began to navigate the Hudson in 1807. He afterwards built others of large dimensions, one of them a frigate, which bore his name. His reputation became established; but lawsuits in reference to certain patents kept him poor, and anxiety and excessive application shortened his days. He died in 1815, in his forty-ninth year. Seeing that as early as 1789 a steam-vessel had been run on the Forth and Clyde Canal, Fulton was not the first to apply steam to navigation, but he was the first to do so with any degree of success.

FUMA'RIA, a genus of plants, the type of the suborder FUMARIEÆ. There are about forty species of Fumaria, which are smooth, slender herbs. *Fumaria capreolata* (rampant fumitory) is a climbing plant, and has cream-coloured flowers tipped with red or purple. *Fumaria officinalis* (common fumitory) grows in cornfields and cultivated land throughout the world, and is plentiful in Britain. The flowers are of a pale red colour, deep red at the summit, with a green keel to the upper and under petals. The leaves are succulent, saline, and bitter. *Fumaria micrantha* is found both in England and in Scotland, and has pale purple flowers in dense spikes. *Fumaria parviflora* resembles *Fumaria officinalis*, but is smaller in all its parts. The flowers are of a pale red colour. It is found in Kent, Essex, and Cambridge, and is also very common in the East Indies, where it is used as a medicine. *Fumaria Vaillantii* is a British species, and is also found in sandy fields in the neighbourhood of Paris and Montpellier.

Fumaria resembles Corydalis in one of the outer petals being spurred or gibbous and the other flat; but there is only one ovule, and the fruit is indehiscent. The species are natives of Europe, Central Asia, and South Africa.

FUMA'RIC, LICH'ENIC, or **PARAMALE'IC ACID** ($C_4H_4O_4$), an acid found in the common fumitory (*Fumaria officinalis*), in Iceland moss (*Lichen islandicus*). and in some other plants. It is isomeric with maleic acid. It crystallizes in various forms, according to the source from which it is derived. It sublimes unaltered at 200° C. (392° Fahr.) It is sparingly soluble in cold, very soluble in hot water, alcohol, and ether. It is a dibasic acid, forming a number of salts known as fumarates.

FUMA'RIEÆ, a small suborder of plants belonging to the order PAPAVERACEÆ. They consist of slender-stemmed herbaceous plants, many of which scramble up others by means of their twisting leaf-stalks. They are rather succulent in texture, with watery juice. *Fumaria officinalis* is one of the commonest of weeds; many are objects of cultivation by the gardener for the sake of their showy flowers; all are reputed diaphoretics. They only inhabit the temperate parts of the world, alike avoiding the extremes of heat and cold. They differ from other Papaveraceæ chiefly in that the two interior petals are unlike the two outer, and that the stamens are definite in number.

FU'MAROLE is a name given to gaseous emanations from holes in lava sheets, either freshly extruded or still hot in the interior. The gases in question are produced by the action of water (percolating through cracks in the lava) upon the hot lava beneath; carbonic acid, sulphurous acid, and sulphuretted hydrogen are the usual products of such action. The sulphur produced by the action of the two last-mentioned gases on each other has led to their being called *suffiones* or *solfataras* by the Italians. The gases and vapours issuing from fumaroles act chemically upon rocks near them; sulphuric acid is a frequent secondary product, and attacks surrounding substances energetically. Thus in Volcano obsidian is found decomposed into a white clay-like substance containing crystals of sulphur and gypsum; frequently the sulphuric acid attacks clay and forms alum, which crystallizes out on the surface. Fumaroles are frequently surrounded by crusts of metallic chlorides, sulphides, and sulphates. They are, of course, confined to volcanic districts, and are found in Hungary, Iceland, Lipari, the Laacher See, the volcanic district of Italy, and many other places of present or recent volcanic activity. Carbonic acid is sometimes emitted by fumaroles in such abundance as to be dangerous or fatal to living creatures venturing near. Dead insects, mice, and birds are frequently found round fumarole vents on the shore of the Laacher See in Rhenish Prussia.

FUMIGA'TION is the application of vapours or fumes for the purpose of removing noxious smells from the atmosphere of apartments, or the persons of those who are in some way infected. The vapours of hot vinegar, burning sulphur, and of aromatic vegetable matters have been long used to counteract unpleasant or unwholesome smells: this is effected chiefly by the formation of such as are stronger. The most important kind of fumigation is that which consists in the employment of such vapours or gases as do not merely conceal unhealthy odours by exciting such as are more powerful, but which by their chemical action prevent the decomposition of animal and vegetable matters.

The fumigation of the first kind, that which is intended to conceal the noxious smell, is now much less employed than formerly. The use of vinegar, of aromatic pastilles, and the smoke of burning brown paper, do not require any particular notice; their operation can hardly be regarded as any other than that of substituting one smell for another. Of late years much attention has been given by scientific men to this subject and valuable results have been attained, many powerful destroyers of the dangerous principles existing in the atmosphere having been discovered, such as Condy's Fluid, which performs its operations by the evolution of ozone, sanitas, carbolic acid, and other preparations. Chlorine is not held in such high estimation as formerly.

FUN'CHAL, the capital and only town of the island of Madeira, is situated on the southern coast. The town consists of a pretty wide street along the sea-shore, where there are several good buildings, and numerous small lanes which extend to a considerable distance up the slope of the hill. The number of inhabitants is 17,000. The town is defended by four forts, and has a cathedral and several churches and convents. In the midst of the town is an open square, planted with trees. It has a very pleasing appearance from the sea, with its white houses rising above one another on declivities, and numerous adjoining villas or *quintas*, embosomed in shrubberies or orchards. The harbour is exposed on the S.E. and S.W. and the entrance is difficult. It is the principal port of the trade of the island. The name Funchal is said to be derived from the abundance of *funcho* or fennel found there.

FUNCTIONS, CALCULUS OF. By the term *function of a quantity* is meant any algebraical expression, or other quantity expressed algebraically or not, which depends for its value upon the first. Thus the circumference of a circle is a function of the radius; the expression $(a^2-x^2)(b^2+y^2)$ is a function of a, b, x, and y.

All algebra is, in one sense, a calculus of functions; but the name is peculiarly appropriated, and is always given, to that branch of investigation in which the *form* of a function is the thing sought, and not its value in any particular case, nor the conditions under which it may have a particular value. For instance, "What is that function of x which, being multiplied by the same function of y, shall give the same function of $x+y$?" is a question of the calculus of functions.

A function of x is denoted by ϕx, ψx, χx, fx, Fx, Φx, &c., the first letter being a symbol of an operation to be performed. Thus Ffx denotes that, when the operation signified by f has been performed upon x, that signified by F is performed upon the result. When the same operation is repeated the results may be denoted by fx, ffx, $fffx$, &c., which may be abbreviated into fx, f^2x, f^3x, &c.

FUNCTIONS, THEORY OF, a name given by Lagrange to his view of the principles of the DIFFERENTIAL CALCULUS. The works of Lagrange in which its details are to be found are "Théorie des Fonctions Analytiques" (first edition, 1797; second edition, 1813); and "Leçons sur le Calcul des Fonctions," of which the first edition is vol. x. of the "Leçons de l'École Normale" (1801), and the second was published in 1806.

If Lagrange's intention were to prove that algebra, as it existed in his time, was sufficient to demonstrate the principles of the differential calculus without the introduction of limits, his end is completely attained. It is manifest that if Taylor's Theorem be demonstrable all the rest follows. Now Lagrange assumes and makes out a strong case in its favour, that every function ϕx has this property, that $\phi(x+h)$ can be expanded in a series of the form $\phi(x+h)=\phi x+Ah+Bh^2+Ch^3+\ldots$ Further, he shows that no negative powers of h can enter the expansion, then that h must be a whole number, and finally that if $h=0$ the whole expansion is reduced to its first term. These points admitted, Lagrange's demonstration of Taylor's Theorem follows the usual course. It is only fair to add that neither the original assumption, nor the three points affecting it, are free from challenge. The objections which are generally made against it also tell against the mode of treating series universally admitted in the last century, and are equally valid against both.

FUNDAMENTAL BASS, a term introduced into musical theory by the French composer Rameau, is the imaginary bass composed of a succession of the root notes of a series of chords. A fundamental bass might therefore be the actual bass if the very unusual occurrence came to pass that all the chords were in their root-positions. Rameau had some curious ideas as to this fundamental bass being limited to progression by fourths or fifths, &c., seeking thus to penetrate the interconnection of chords. They are, however, now abandoned. Dr. Day in his method of writing "figured bass" uses the fundamental bass indirectly; that is to say, he indicates by a letter what relation the actual bass is to the root or fundamental bass. (A means that the root is the bass, B that the third to the root is the bass, C the fifth, &c.) The figures accompanying these letters relate to the fundamental bass, not to the actual bass. See FIGURED BASS.

FUNDAMENTAL DISCORDS. See DISCORDS.

FUNDAMENTAL TONE, in musical theory, is the prime tone or first (lowest) partial tone of a musical note. In the very rare case of a simple tone (such as that from a tuning fork held over a resonance jar, &c.) the fundamental tone exists alone; but in the vast majority of musical sounds certain other tones (or partials) are heard above the prime, and all melting together make up a compound tone, which gives the effect of the fundamental tone greatly increased in richness. Upon the relative strength and number of these upper partials depends the quality of the tone produced, that which distinguishes a fiddle from a flute. See the concluding part of the article ACOUSTICS.

FUNDY, BAY OF, an arm of the Atlantic, between Nova Scotia on the S.E. and New Brunswick and Maine on the N.W. Its length is 100 miles, and its mean breadth about 30 miles. The river St. John falls into it at the town of the same name. The bay is remarkable for the highest tides in the world. The set is extremely rapid, and the height often as great as 120 feet. This arises from the circumstance that the opening of the bay is directed towards the advancing crest of the tide-wave sweeping up the Atlantic from the Cape of Good Hope. It is one of the grandest scenes in nature to witness from a high cliff the advance, under a south-west wind, of this tide-wave, with its ceaseless, deafening roar and rapid rise of 20 feet per hour, against the rocky sides of the bay.

FU'NEN or **FUHNEN** (in Danish *Fyen*), an island in the Baltic, separated by the Little Belt from Schleswig and Jutland, and by the Great Belt from the island of Zealand, lies between 55° 2′ and 55° 37′ N. lat., 9° 42′ and 10° 45′ E. lon. Its greatest length is 50 miles, and its mean breadth 33 miles. Its area is about 1250 square miles, and its population 210,000. The surface is level, varied by low hills in the southern districts. The north-east of the island is deeply indented with bays extending from the Cattegat, particularly the Odense Fiord. The soil is in general rich and productive. Fünen abounds in small streams, here called *aas*, and lakes; there are also several peat-moors. The climate is damp and variable, but milder than that of Zealand. The principal crops are barley, oats, and buckwheat. Much flax, hemp, and hops are raised. With the exception of potatoes, the cultivation of vegetables is limited; but the orchards are numerous, and an inferior kind of cider is made. Horses, horned cattle, sheep, and swine are numerous. There is a great quantity of wild-fowl and poultry, especially geese. The fisheries are productive. The only minerals are freestone, chalk, and limestone. There are no manufactures of importance.

The exports consist of corn, spirits, apples, horses, oxen, butter, salted meat, tallow, hides, hops, linen, honey, and wax. Odense, which by its canal has a direct access to the sea, is the great trading mart and capital of the island. The only good road is that from Middelfart to Odense.

FUNERAL. The manner of disposing of the dead has varied in different nations, but the most general modes have been interment and burning. The practice of burying is perhaps the oldest, and it is certainly the most widespread; but the custom of burning the body, and afterwards depositing the ashes in a tomb or urn, became general among the Greeks and Romans, and it is still practised over the greater part of Asia, with the exception of China, where burial is the rule. The way in which the ancient Egyptians disposed of their dead is described under EMBALMING. Another method, viz. that of exposing the bodies of the dead to the influences of the atmosphere and the ravages of beasts and birds, prevails among many nomadic tribes, and is retained also by the cultured Parsees of India.

The places set apart for burial were by the ancient Greeks always placed outside the cities, and among the Romans the tombs were generally placed by the sides of the public roads. The early Christians also buried outside cities, and called the burial-places cemeteries, from a Greek term signifying a place of rest or sleep. [See CEMETERIES.] At a later period the burial-places were transferred to the churches and the graveyards surrounding them, a practice that has been continued until the present

day. This practice, however, was attended with many serious inconveniences in the cases of such churches as were situated in towns, and about the middle of the present century the system of intramural funerals was strongly assailed by sanitary reformers. It was pointed out that where churches had become surrounded by houses, the putrid exhalations arising during the decomposition of the bodies placed in the graveyards were very injurious to health, and gave rise to and encouraged the progress of numerous diseases. Further, it was pointed out that many of these places had been used for so long a period that it was dangerous even to turn up the earth they contained, while such soil was quite unsuited for further interments. The attention of the legislature was directed to the matter, and certain measures were carried by which all graveyards situated in crowded cities were closed, and the interments in open cemeteries were placed under sanitary control. In 1850 the Board of Health was made a burial board for London, and power given to the Privy Council to close the city churchyards. The Act was extended to the provinces in 1853, and to Scotland in 1855. Though the result of these measures was to remove many of the worst of the evils that had prevailed previously, there are many sanitary authorities who contend that the present system is also fraught with danger to health. Where a large number of bodies are deposited in a limited space, as is the case in most town cemeteries, unless great care is exercised both the air and water of the neighbourhood are liable to contamination. Hence it has been proposed to resume the practice of cremation, and several societies for this purpose have been established in England and on the Continent. By the methods introduced by these societies the bodies of the dead can be reduced to ashes in a very short time, at a small cost, and without danger or inconvenience to the living, but the practice makes way very slowly in Europe.

Wherever Christianity has prevailed it has been customary to inter the dead with religious ceremonies indicative of the hopes of a resurrection. The funeral rites of the Roman Catholic Church are very solemn and ceremonious, and the body remains under the care of the church from the moment of death until it is laid in the consecrated ground. The funeral service of the Church of England is also very beautiful and impressive, and some societies have been formed among the ritualists for the purpose of emphasizing the doctrines of Christianity in connection with the disposal of the dead. Most of the dissenting churches of Great Britain conduct religious services at funerals, and by the Burial Laws Amendment Act of 1880 dissenting ministers may conduct such services in churchyards by giving due notice to the rector, vicar, or incumbent of the parish. [See BURIAL REGULATIONS.] In Scotland it is not customary to hold any religious service in the cemetery or graveyard, but it is usual for a minister to offer prayer and to read a chapter of Scripture before the body is taken from the house.

Throughout Europe the ordinary cortége of a funeral is a hearse with a bier, on which is the coffin, covered with a pall, followed by carriages in black with black horses. In England the hearse is generally closed, and is sometimes decorated with plumes. In country districts the coffin is often carried by straps, or borne on the shoulders of bearers. All the mourners and attendants wear black clothes, and the wearing of black as a sign of mourning is a custom that is followed by all classes of society.

Until a comparatively recent period funerals were conducted in an extravagantly expensive manner, and it was estimated that in England and Wales more than £5,000,000 were annually spent in this way. During late years many attempts have been made to reduce these unnecessary expenses, and it is now becoming more and more general for persons to direct that their interment shall be as plain and simple as possible.

FUNERAL ORATIONS, discourses at funerals. The second book of Thucydides (c. 35, &c.) contains the harangue delivered by Pericles at the funeral ceremony in honour of those Athenians who fell at the beginning of the Peloponnesian war. It was also an invariable Roman fashion to deliver such harangues. Nero pronounced a funeral oration over his wife Poppæa. Funeral orations were common over Christian martyrs, and funeral sermons are sometimes delivered in English churches.

The practice of delivering what may be properly called funeral orations, that is, addresses by laymen over the grave or at the interment of the dead, is at the present day common among the French, and is not unfrequent on great occasions among the people of the United States.

FUNERAL RITES, among the ancients. These were of surpassing importance. The Greek superstition that the unburied spirit could not find rest lent an additional value to funeral ceremonies. The corpse had a small coin (*obolus*) put in its mouth, wherewith to pay the fare of Charon, the ferryman of the Styx, who transported the souls of the dead into the shades of Hades. Washed and perfumed, the head crowned with flowers, it was then dressed in the handsomest garment procurable, and laid upon a couch by the ladies of the family. No servant was allowed to touch it. Vessels of water stood before the door, that all who approached the corpse might purify themselves by sprinkling. Earthen vessels containing honey-cake, corn, oil, wine, &c., were buried with the body. This was either interred, as with ourselves, or burnt, and the ashes buried in a vase. All tombs were outside the city, probably for sanitary reasons. A Greek city, like a Roman, was therefore approached by lines of tombs, which clustered round all the roads leading to the city gates. Orations were not allowed except for public funerals. Mourning lasted in Attica thirty days, in Sparta eleven days, during which time the family wore black clothes, and did not usually leave the house.

Among the Romans even greater honours were paid to the dead. As the Roman citizen died his relative endeavoured to catch his last breath in his own mouth, then removed his signet ring, and bade him farewell (*vale*) by name. The perfuming, dressing, and placing of a coin in the mouth were borrowed from the Greeks. Magistrates wore their robes of office, and any personal decorations, as crowns of honour, &c., were also placed upon the deceased. On the eighth day after death the body, on as splendid a couch as possible, was carried out of the house on the shoulders of relatives or freed slaves. In the case of public men great persons (senators, &c.) would help as bearers, and the body was carried to the forum, there to have orations spoken over it, thence to the place of burning outside the city. Bands of wailing women, musicians, and dancers preceded the couch of the dead: one of the comedians was dressed like him, and imitated his walk and gesture. Following this mimicry of the departed was a body of actors representing all the notable ancestors of the deceased, suitably dressed to represent those personages and wearing masks which had been copied from them, and a collection of which always ornamented the atrium of a wealthy Roman. Especially proud was the family if this ghostly procession could show a consul or two, a prætor, or a censor; and in this case the state lictors, &c., accompanied the comedian as they would have done the great ancestor of the departed in his life. The family, all in black, followed—the sons with veiled heads, the daughters unveiled; then the clients and freedmen and friends. Arrived at the forum the corpse was supported in an erect posture while the notable deeds of the deceased were recited and eulogized to his face. Many interesting descriptions of this imposing ceremony remain.

Burning was rather a late practice. Sulla was the first of the Cornelian gens whose body was burnt. But once

introduced it spread rapidly; not only as being evidently healthy, but also as permitting the ashes of the departed to be reverently preserved and his memory to be associated with nothing loathsome or corrupted by decay. This lasted till Christianity became a state religion under Constantine (sole emperor in 323), when burial generally returned into favour. The place of burning was the *bustum*, and as a statue of the dead man was very frequently erected over his tomb as a memorial, such statues, being usually of the head and neck only, have come to be known as *busts*. The ashes were collected from the pyre, soaked in wine, and enshrined in an urn, with a suitable inscription carved on its side. Large tombs, with niches in the walls to receive hundreds of urns, were provided for poorer people who could not buy land enough nor were rich enough to erect a tomb. From their dovecot-like appearance they were called *columbaria*. Roman mourning was originally black, and under the empire remained black for the men, but the ladies of the empire wore white. The hair was untrimmed during the few days that the mourning lasted.

The word *funus*, whence funeral is derived, means torch; for in the early times all Roman funerals were at night, that magistrates and priests might not be made unclean and their duties hindered by the sight or touch of a corpse. When the splendid ceremonies grew fashionable, however, only those too poor to afford them continued to hold their funerals by night in the ancient way.

FUNERAL SHOWS or GAMES frequently followed public funerals among the Greeks and Romans. An early example of this occurs in the funeral games celebrated by Achilles in honour of Patroclus. At the funeral of P. Licinius Crassus, Pontifex Maximus, 120 gladiators fought, and the games lasted three days. The "Adelphi" of Terence was produced for the first time at the funeral of Lucius Æmilius Paulus.

FUNF'KIRCHEN ("Five Churches;" Hungarian, *Pecs*), an old town in the county of Baranya in Hungary, and the seat of provincial administration, stands at the foot of Mount Metshek, and at the edge of a rich and extensive valley, 105 miles S.S.W. of Buda. It has 24,000 inhabitants. It contains several handsome buildings, an episcopal palace, an ecclesiastical seminary, a gymnasium, a cathedral, said to have been founded in 1009 and to be the oldest in Hungary; several churches, some of which were formerly Turkish mosques; a public library and cabinet of coins, two hospitals, &c. In the vinicity are coal-mines, alum and vitriol works, and extensive vineyards. Large quantities of corn and tobacco are grown about Fünfkirchen, and much rape-seed is raised for making oil. The trade of the town is chiefly in the produce of the country, and in leather. There are mineral springs and baths, and manufactures of woollen cloths. Fünfkirchen is one of the most pleasantly situated and beautiful towns of Hungary. The Turks held it from 1543 to 1686.

FUN'GIC ACID, a little-known acid existing in most of the fungi.

FUNGIC'OLA is a group of beetles belonging to the section TRIMERA. The antennæ are long, the last three joints forming a flattened club. The maxillary palps have the last joint thread-like. The legs are long. In some tropical species the elytra have a broad dilated margin, and are armed with large spines or hooks. This group includes only one family, Endomychidæ. The species feed, in some cases both in their larval and perfect condition, on fungi and boleti, especially those growing on the surface of rotten timber. The species are numerous, but chiefly confined to the tropical regions of both hemispheres. Only two species are found in Britain, *Lycoperdina bovistæ*, found in the puff-ball, and the pretty scarlet and black-spotted *Endomychus coccineus*.

FUN'GIN, the cellulose or cellular fabric of the fungi.

FUN'GUS, a class of the cellular CRYPTOGAMIA, which includes agarics (toadstools, mushrooms, &c.), truffles, puff-balls, mildew, mould, blight, &c. They have no green colouring matter (chlorophyll) like other members of the vegetable kingdom, and cannot therefore use carbonic acid as food; very many of them live upon decaying organic matter, or in a state of parasitism upon living beings. The word *mycology* is used to denote the science of fungi; it is derived from the Greek *mukes*, whence also the termination *mycetes* for many of the orders of fungi.

Fungi are composed of elongated cells, called *hyphæ*. An exception occurs in the case of the group Myxomycetes, about which so much discussion has taken place, some biologists even classing them in the animal kingdom. The *mycelium* of fungi consists of hyphæ, which are concerned in the absorption of nutriment; a good example is the mushroom spawn. In the case of parasitic fungi, as for instance that which produces potato-disease, certain of the hyphæ of the mycelium are modified to form haustoria, which penetrate the cells and extract nourishment. A *sclerotium* is a tuberous or wart-like body, formed by the concentration of hyphæ densely interwoven. One of the best known sclerotia is ERGOT. The *hymenium* is that part of the surface of a fungus which bears the reproductive bodies or spores. The gills of the mushroom and the pores of boletus are hymenia.

Fungi are generally very nitrogenous, and this is the reason why so many form nutritious articles of food; many a poor family in France, Russia, &c., dine well off a single large fungus. Many fungi are poisonous, but even these steeped in vinegar become wholesome. Dr. Badham has written a useful book on those which are fit for food, "The Esculent Funguses of England." Yeast and some other fungi produce fermentation. Fungi are often very destructive — for instance, dry-rot, hop-mould, coffee-disease, potato-disease, wheat mildew, and ergot.

Following the classification of De Bary, fungi may be divided into the following orders and suborders:—

Order I., Phycomycetes is composed of the suborders Saprolegnieæ (example, the salmon-disease fungus), Peronosporeæ (the potato-disease), and Mucorini (fruit-mould). Order II., Hypodermiæ contains Uredineæ (wheat-mildew) and Ustilagineæ (smut of corn). Order III., Basidiomycetes is composed of Tremellini (*Tremella mesenterica*, fig. 9 of Plate FUNGUS), Hymenomycetes (*Agaricus mollis*, fig. 1; *Trametes gibbosa*, fig. 2; *Merulius lachrymans*, fig. 3; *Boletus*, fig. 4; *Hydnum coralloides*, fig. 5; *Clavaria rugosa*, fig. 6), and Gasteromycetes (*Batarrea phalloides*, fig. 10; *Cyathus vernicosus*, fig. 11; *Lycoperdon giganteum*, fig. 14). Order IV., Ascomycetes is composed of Discomycetes (*Morchella esculenta*, fig. 7; *Peziza aurantia*, fig. 8), Erysipheæ (white-mildew), Tuberaceæ (the truffle), Pyrenomycetes (*Xylaria hypoxylon*, fig. 12; *Sphæria*, fig. 13; *Nectria cinnabarina*, fig. 15), and Lichenes. "Flowers of tan" is an example of order Myxomycetes. Order Schizomycetes contains Bacteria, &c.

For British fungi, see "Handbook of British Fungi," by M. C. Cooke.

FUNGUS, in medicine, is a term applied to such superficial granulations and such morbid growths of a malignant character as are of a soft mushroom-like character and of rapid growth. When the pedicle of such a growth is long and slender it is termed a polypus.

FUNIC'ULAR MACHINE is a name given by some mechanicians to a chord or chain attached at one extremity to an immovable point, the other end passing over a fixed pulley or friction wheel, and having a weight suspended from it; a weight being also suspended from the chord or chain in some part of its length between the fixed extremity and the pulley. The chord or chain becomes thus a mechanical agent, since unequal weights, applied as has been said, may be in equilibrium.

FUNICULAR RAILWAYS are those which depend upon motive power imparted to an endless chain or rope (*funiculus*). This being wound round drums drags along carriages, &c., fixed to it. With suitable clutch-breaks to guard against damage from broken chains, such railways are safer for steep ascents than those depending on cogs (as the Righi Railway), or on the bits of horizontal wheels on a third rail. There is an excellent funicular railway up the cone of Mount Vesuvius, an exceedingly steep acclivity.

FUNNEL, a hollow conical vessel with a small pipe issuing from its apex, much used in domestic life for conveying fluids into vessels of small apertures, and in chemical operations not only for this purpose but for that of filtering. Locally it is sometimes called a "tun-dish" or a "filler." Funnel is also applied to the iron tube which carries off the smoke from the engine fires of steamships, locomotives, &c., and which, by its height, creates the draught necessary for combustion purposes.

FUR is the name commonly given to the incrustation which forms on the inside of vessels when calcareous water is boiled for any length of time in them. It is usually a deposit of carbonate of lime with small quantities of other mineral matters. As it is a bad conductor of heat its presence in steam boilers is very objectionable, and various means have been tried to prevent its formation. Some of these have proved partially successful, but the evil has not up to the present been fully conquered. For the fur of animals see FURS.

FUR'CA (Lat., a fork), among the Romans, an implement of punishment, consisting of a strong piece of wood resembling a fork, whence it derived its name. There were different kinds of punishment, as the *furca ignominiosa*, when a slave (they had no free servants), by way of disgrace, was obliged publicly to carry the furca on his shoulders, his arms being tied to the two projecting limbs of the furca; the *furca pœnalis*, when a criminal, in addition to carrying the furca, received a public whipping; and the *furca capitalis*, which was inflicted for a capital felony, when the malefactor was whipped to death, with the furca fastened about his neck. The Chinese CANG is a closely analogous instrument of correction. In the feudal age the furca was in some measure retained, under different modifications, as an implement of punishment. Thus *furca et fossa* was a privilege granted by our kings of summarily punishing felons by hanging or drowning—men by the former, and women by the latter mode. *Furca et flagellum* was a kind of feudal subjection, according to which the bondmen were at the disposal of their lord for life or limb.

FUR'FURINE ($C_{15}H_{12}N_2O_3$) is an organic base obtained from furfuramide ($C_{15}H_{12}N_2O_3$), a crystalline amide formed by the action of ammonia on furfurol, or oil of bran obtained by distilling bran with dilute sulphuric acid. On boiling furfuramide with a somewhat dilute solution of caustic potash, this substance is slowly dissolved, and the resulting solution on cooling deposits small white crystals of furfurine. It is a powerful organic base, forming with acids a series of beautiful crystalline salts. It is sparingly soluble in cold water, dissolving in about 135 parts at 212° Fahr. It dissolves readily in alcohol or ether. It was discovered by the late Professor Fownes, and is remarkable as being the first organic base produced artificially.

FUR'LONG, the eighth part of a mile, viz. 220 yards. It is the *furrow-long*, the length of an ordinary furrow in the fields of our English ancestors.

FUR'LOUGH, leave of absence granted to soldiers, either periodically or upon extraordinary occasions, to enable them to visit their friends or recruit their strength in cases of ill health. The furlough of an officer in the royal service is called "leave of absence." Non-commissioned officers and privates on furlough must be provided with a pass, or they are liable to be seized and dealt with as deserters.

FURNACE. A furnace is a closed, or partially closed, chamber in which the heat derived from the combustion of fuel is used. The design or form may vary within wide limits, as may also the mode of applying and using the fuel, and the purpose to which the heat is applied, or the nature of the operation which is carried out by its means, without invalidating this general definition.

In this view the open *grate* which is used for domestic purposes cannot be classed as a furnace, and the propriety of denominating other heating appliances *stoves*, *hearths*, and the like, which are either not closed chambers in any sense, or the heating effects of which are utilized outside of the appliance, is apparent.

On the other hand, *kilns*, which are used in the manufacture of bricks, pottery, &c., may be considered as furnaces, even although a very large proportion of the heat developed in them from the fuel is uselessly dissipated in the cooling of their contents. Some modern forms of these, however, fully vindicate their claim to be classed as furnaces.

Muffles and *ovens*, other than coke ovens, form another section of heating appliances which are closely allied to furnaces—in fact, the muffle is a chamber which is placed inside of a heating furnace, and which contains the substance to be operated upon by the heat, which is transmitted to it through the brick, clay, or metal of the muffle. The oven has features in common with the muffle furnace, but differs from it in not having the inner chamber movable, while sometimes movable muffles are used. In some respects crucibles, retorts, and cupels placed in a furnace fulfil the conditions of muffles.

Combustion is carried on in furnaces by means of air supplied either as a blast by mechanical means, or by the natural action of chimney "draught;" and the fuel as introduced into the furnace may be either solid, liquid, or gaseous. In cases where gaseous fuel is supplied to furnaces, it is produced from solid fuel (coal, coke, wood, lignite, or shale) in separate chambers termed "gas producers."

It is probable that the first efforts to obtain high temperatures by combustion were made in connection with the reduction of metals from their ores, and by means of an air blast produced by manual labour or other artificial means. The *Catalan forge*, with its "trompe" or water-jet blowing apparatus, and the old-fashioned *smithy hearth*, with its hand or foot-bellows, are examples of the oldest of such appliances with which we are acquainted.

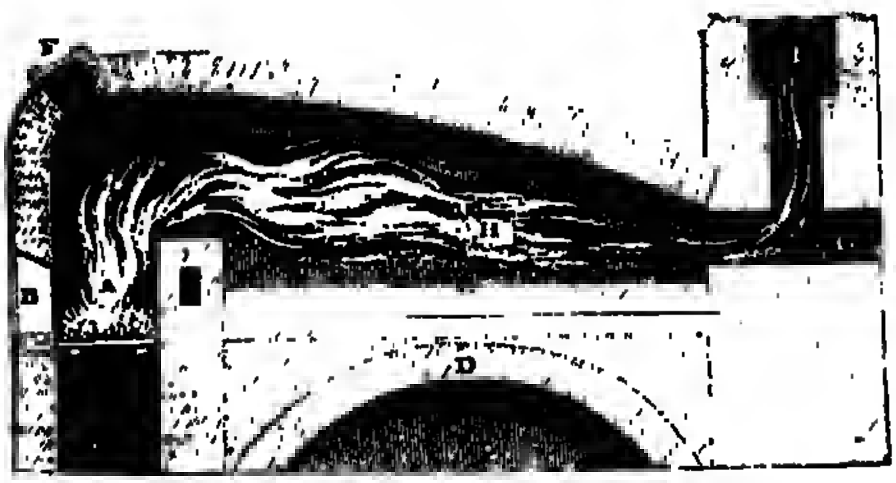
The *blast furnace*, which is used in the manufacture of pig iron, is no doubt a development from these early ideas, so that historically furnaces worked by air blast, as distinguished from natural draught, come first.

The blast furnace is a vertical structure of dimensions which vary according to the class of ore and fuel used in the district in which it is built. Its structure is of brick inside or throughout, or of brick inside and a casing of iron or of stone. Its form is now generally circular, although at one time it was built square for some part of its height. When not cased with wrought-iron plates it is often bound with iron rings or hoops. The solid fuel (coal or coke, sometimes lignite) is charged along with the ore and fluxes at the top of the furnace, or "tunnel-head," and the blast, which is now almost always heated, is supplied through tuyeres near the bottom. The top of the furnace is now usually closed by a movable bell-cone, in order to permit the large volume of combustible gases which is given off to be conducted to various other furnaces where these gases may be usefully consumed, instead of their being allowed to escape into and burn uselessly in contact with the air at the blast furnace top. See BLAST FURNACE.

The *cupola*, which is used for melting pig iron for foundry purposes, is a miniature blast furnace with an open top. In this furnace coke is the fuel almost always employed, and the blast is seldom if ever heated.

One of the earliest and perhaps the most typical form of furnaces using solid fuel with air-supply produced by natural or chimney draught, is the *reverberatory furnace*, as used for puddling and for heating iron and steel. It is also used for many other purposes in the arts and manufactures, and the principle of its construction is applied to a variety of designs, including those in which the body of the furnace consists of a movable or revolving chamber, as

Fig. 1.

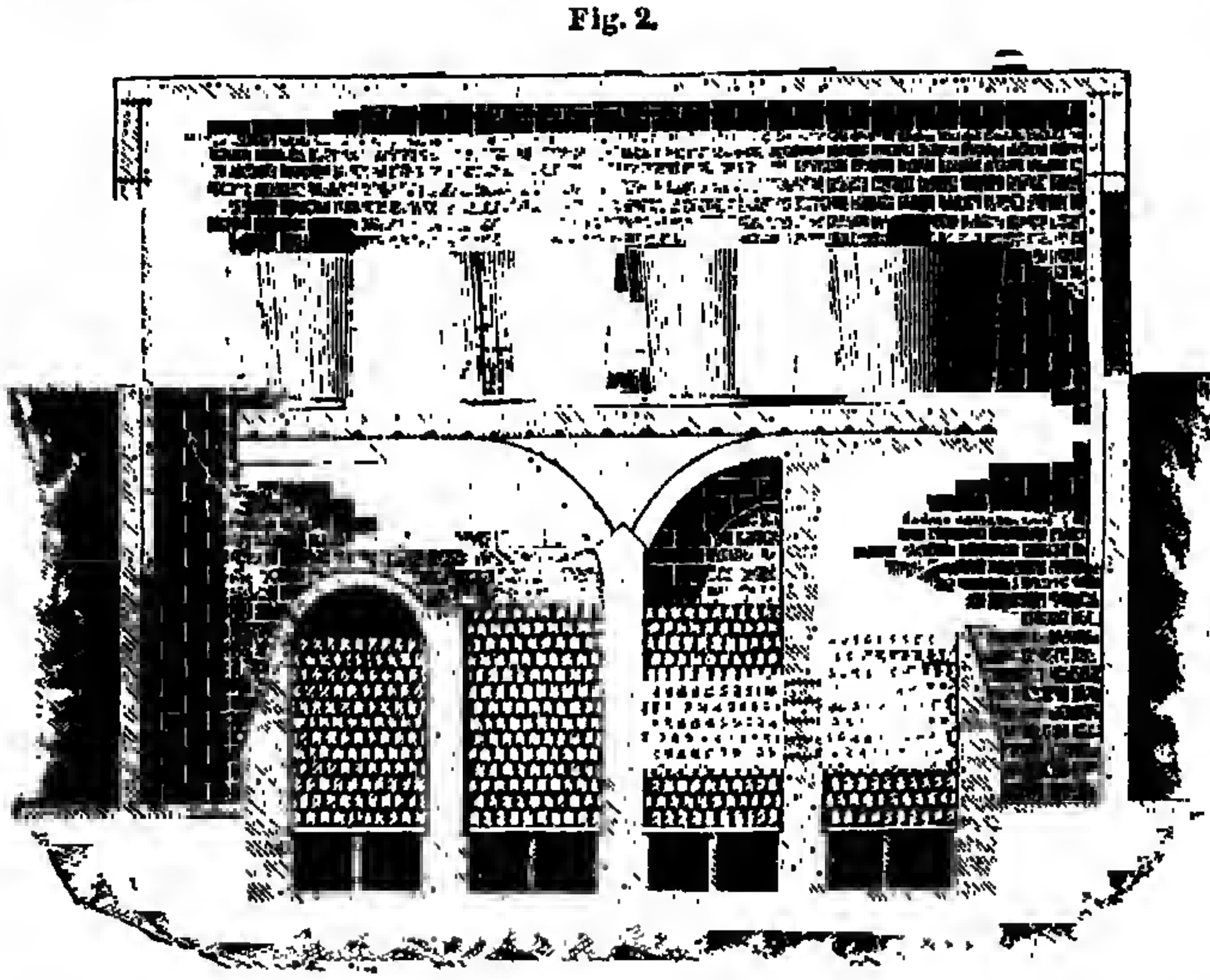


in the *Pernot furnace*, *Mactear's revolving chemical furnace*, the *Jones & Walsh chemical furnace*, the *Danks puddling furnace*, and others.

The ordinary reverberatory furnace (fig. 1) consists essentially of a grate or fireplace, with bars, A, a firing-door, B, a bed, C, divided from the fireplace by a bridge, E, or fire-brick wall, a curved or sloping roof or crown, which causes the flame to *reverberate* on to the charge placed on the furnace bottom or bed, and a chimney or stack, I, connected to the furnace by a neck, G, which narrows and dips downwards towards the chimney. The sides and roof are usually bound by iron plates, buckstaffs, and tie-rods, and the bottom in puddling furnaces is also carried on iron plates, having a channel or passage for air underneath.

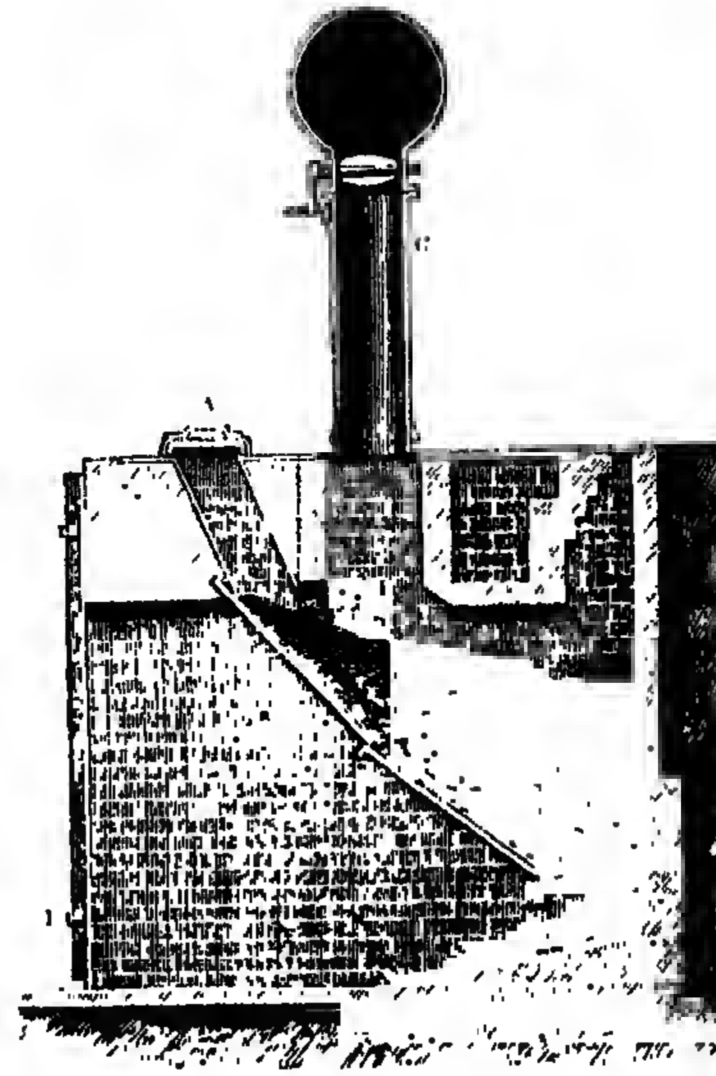
In order to obtain high temperatures by the use of an inferior class of coal, the method has been adopted in some

Fig. 2.



furnaces of working with blast or draught produced artificially, in order to secure more rapid combustion. This artificial quickening of the draught has been produced by a steam-jet in the chimney, as in *Perkins & Smellie's furnace*, combined with arrangements for heating the air supply before it is drawn through the fire. It has also been attained by the use of Körting steam-jet blowers, arranged to force air and steam under the grate into the ash-pit, which is closed for this purpose. A third method finds its illustration in *Wittenström's "Lancefield" furnace*, in which air is forced by a fan both under and over the fuel in a combustion chamber, the products of

Fig. 3.



combustion escaping by the furnace doors, and no chimney being used.

Attempts more or less successful have been made to utilize the waste heat usually carried off by the waste gases by heating the supply of air used for combustion, as in some of the furnaces named, and also in *Caddick & Mabery's furnace*, *Head's "Newport" furnace*, and others; by heating both the fuel and the air, as in *Price's "retort" furnace*; and by raising steam, as is common in many forges and rolling mills. For this latter purpose the waste gases, after leaving the furnace, are led through the flues of either vertical or horizontal steam boilers.

Economy was also sought by *Crampton's furnace*, which was arranged for the combustion of finely powdered fuel, forced into the furnace by means of an air blast. The greatest economy has, however, been attained by the use of gaseous fuel, and foremost among the plans introduced for this purpose stands the *regenerative furnace of Siemens*.

Prior to the introduction of the Siemens furnace there were furnaces in use in Sweden in which combustible gas, produced by the partial combustion of fuel, was used along with a blast of air supplied by a fan and heated by some of the waste heat escaping by the chimney. Of these *Ekman's furnace* is illustrated by Percy in his "Metallurgy," and in Knapp's "Technology."

In Siemens' design a furnace (fig. 2) of a form varying according as it is to be employed for melting steel in a bath or in crucibles, for melting glass in pots or in a continuous tank, for puddling or for reheating iron or steel, or for other purposes, is mounted upon two pairs of "regenerators," which are rectangular chambers built of fire-brick with semicircular arched roofs. These chambers are filled or nearly filled with fire-bricks stacked dry, so as to form a fretwork, exposing a large surface alternately to heating and cooling actions. Passages connect the tops of each pair of these chambers with one end of the furnace, or with either inlet or exit ports in it, while the bottom of the chambers is connected by other passages with reversing valves of cast iron, through which the gas from the producers and the air-supply pass, and are directed first separately through one pair of regenerators which have been heated by the escaping gases, then through the furnace, in which combustion takes place by the union of the gas and air, and lastly, as highly heated products of combustion, through the other pair of regenerators, to which they impart the greater part of their heat, and by the reversing valve to the chimney flue. The direction of the currents of air and gas is reversed at stated intervals, so that each pair of regenerators alternately store up waste heat and impart it to the incoming gas and air prior to combustion taking place. This is done with the minimum of loss, as the same brick surfaces which are heated by contact with the hot waste gases are brought into contact with the gas and air which are to be heated up. The original form of the Siemens gas producer is shown in fig. 3, the fuel being introduced by the opening, A, and the air necessary for combustion by B, while the resulting gases escape by the tube, C.

These arrangements are successful in producing economically the highest temperatures used in the arts, and the same principle has been introduced with success in other plans, notably in that of *Mr. Dunnachie's fire-brick kilns*, in which a chamber full of freshly-burned bricks becomes a regenerator to heat up the air used for combustion (with gas from a producer) in another adjoining chamber.

Attempts have also been made with more or less success to heat the incoming air (for combustion with gaseous

Fig. 4.

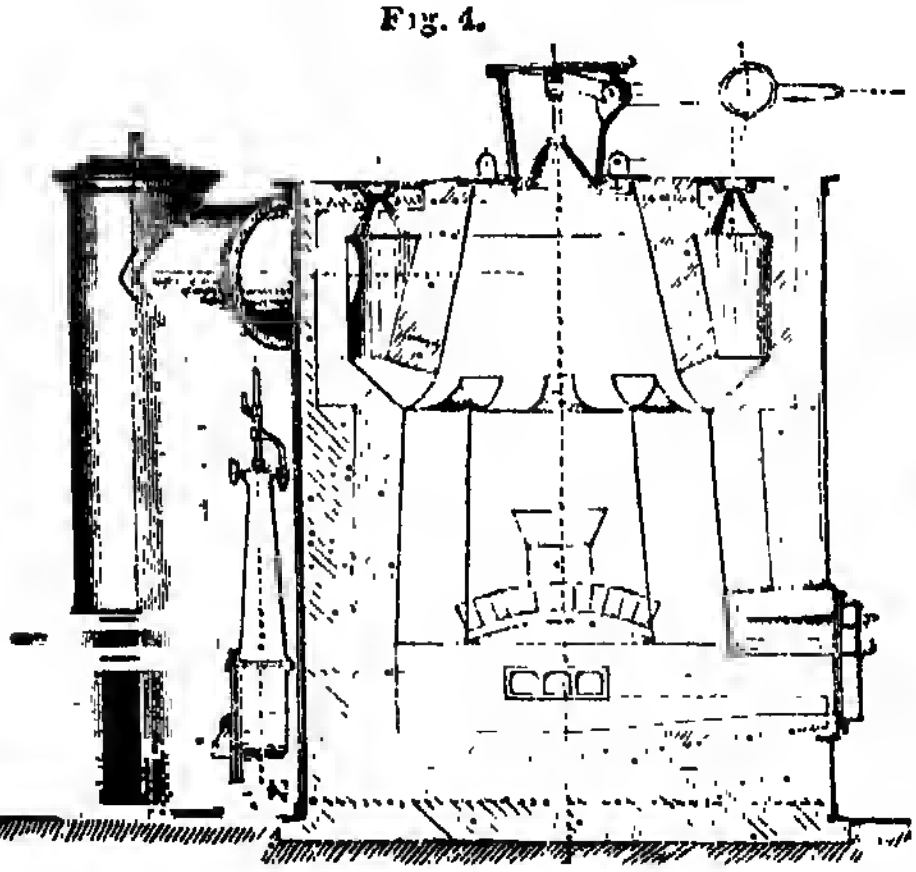
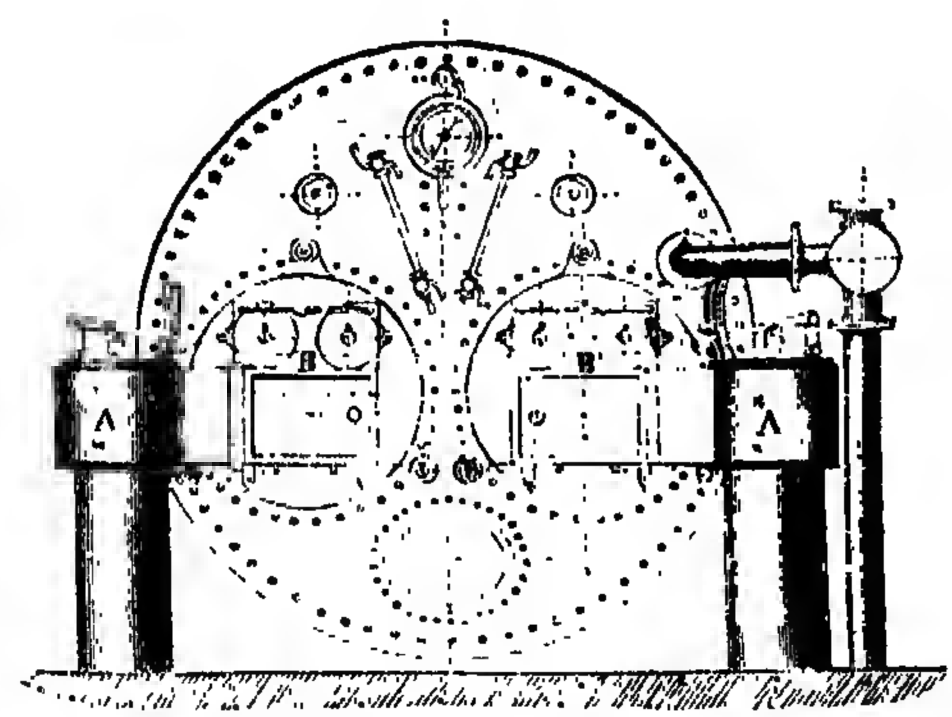


Fig. 5.



fuel) continuously by transmission of the heat from the waste gases through thin partitions of fire-brick, which separate the ascending current of air from the descending current of waste gases. Of this class of furnaces are the *Ponsard furnace*, with its recuperator; the *Gorman furnace*, with its heat-restoring chamber, and some furnaces introduced by Mr. Alfred Wilson, whose gas-producer (illustrated in fig. 4) has taken a foremost place in connection with the working of Siemens and other furnaces worked with gas. The form of grate used in the Siemens producer has been introduced into the *Boetius furnace*, the *Bicheroux furnace*, and the *Smith-Casson furnace*.

In firing steam boilers with solid fuel an ordinary grate is placed either under the boiler, which then takes the place of the roof of a furnace, or inside a boiler flue, which wholly incloses the grate, air being admitted through the furnace door and under the fire-bars. See BOILER.

In applying gaseous fuel to boiler firing (fig. 5), the gas is led through a regulating valve, A, to the front of the furnace or combustion chamber, and air for combustion is admitted through an adjustable grating, B, in the furnace door.

FURNACE, ELECTRIC, a valuable invention of Dr. Siemens completed just before his death, in 1883. The furnace consists of a crucible of any convenient size, in the bottom of which is pierced a hole to receive the positive electrode, the negative electrode, which passes through a hole in the lid of the crucible, being suspended from one end of a beam, the other end of which is attached to a hollow cylinder of soft iron free to move vertically within a solenoid coil of wire. The force with which the cylinder is drawn into the coil can be counterpoised by a sliding weight on the beam. One end of the solenoid coil is connected with the positive, and the other with the negative pole. The coil having a high resistance, its attractive force on the cylinder is proportional to the electro-motive force between the electrodes, *i.e.* to the resistance of the arc. The length of the arc is, therefore, regulated automatically, and the extinction of the arc by sudden change in its resistance, or by the sinking of the material in the crucible, is thus avoided. The crucible is surrounded with some infusible substance, which is also a poor conductor of heat, and gas-retort carbon or sand answers well for this purpose. The electrodes may be of such carbon as is used in electric lighting, or of any other convenient conducting substance, and may, if desired, be cooled by circulating water through or round them, or by exposing them as far as possible to the air. In one experiment a $\frac{1}{2}$ inch nickel positive pole was employed, the lower end being inserted in a solid rod of copper about 1 inch square and 6 inches long. With this pole 1 lb. of grain nickel was fused in a clay crucible and poured in eight minutes, starting with everything cold. The electrode was attacked but little, and no leakage occurred.

Two great advantages claimed for the electric furnace are, that the temperature attainable is practically limited

only by the refractoriness of the material of which the furnace is constructed, and that the heat is developed immediately in the material to be fused, instead of first having to pass through the containing vessel. Dr. Siemens used very refractory clay crucibles, which, however, were invariably cut through in a few minutes, and, except for experiments of short duration, were useless. Plumbago crucibles yield much better results, but tend to cause carburization of the metal experimented with. In some experiments the fusion of metal was effected in a bed of lime, sand, or electric-light carbon dust. As far as the limit of the temperature which may be produced by an electric furnace is concerned, Dr. Siemens remarked, when describing the furnace before the British Association, that it is yet unknown, for although the heat would probably increase the resistance of the arc, that in itself would cause only a further development of heat.

FURNEAUX ISLANDS, a group lying in Bass Strait, between Tasmania and Australia, were discovered in 1773 by the navigator whose name they bear, and who was second in command under Cook. The largest of these, Flinders Island, is 35 miles in length by 10 in breadth. The next in size are Cape Barren, Clarke, Hummock, and Babel. There are also a number of small size. They lie in lat. 40° S. by 148° E. lon., and belong to Tasmania.

FURS—FUR TRADE—FUR DRESSING. The covering of the skin of many animals is constituted of two kinds of hair, one of which is silky, soft, and curly, and is called fur, and the other is straight and comparatively coarse, and is distinguished as the overhair. Those animals which yield fur in sufficient abundance for commercial purposes are generally found in cold climates, such as the high latitudes of North America, Siberia, and Northern Europe.

The fur trade was early taken up by the French colonists of Canada, and through the ignorance of the Indians the traders at first made very great profits. When the hunting season was over the Indians came down to Ottawa in their canoes, and encamped outside the town of Montreal, where a kind of fair was held until the furs were all exchanged for trinkets, &c. At a later period, European settlers, under the name *coureurs des bois*, or wood-rangers, set out at the proper season for Montreal in canoes loaded with various articles, and proceeded up the river to the hunting grounds, where they conducted their traffic with the hunters.

The Hudson Bay Company, established with the object of procuring furs, was granted a charter by Charles II. in 1670. This association founded several establishments, but the trade they carried on, though said to have been a profitable one, was of very limited extent. As the company's charter was never confirmed by any Act of Parliament, all British subjects were lawfully entitled to trade with those regions; though from the difficulties attached to the trade, the protection required in carrying it on, and the undisguised hostility which private traders experienced from the agents of the company, the latter were allowed to monopolize it to a great extent for more than a century with but little effective opposition. In 1783-84, however, some traders engaged in the fur trade of Canada formed themselves into an association, known by the name of the North-west Company, having their chief establishment at Montreal. This new company prosecuted the trade with great enterprise, and with so much success that they seemed to have roused the latent energies of the Hudson Bay Company, and the conflicting interests and pretensions of the two associations were naturally productive of much jealousy and ill-will. At length, in 1821, an amalgamation took place between the companies, and the trade was afterwards prosecuted peacefully and successfully. In 1869 the territories of the company were sold to Canada for £300,000, but it was allowed to retain its stations. All the furs are shipped to London, some from their factories at York Fort and on Moose River, in Hudson Bay, other portions from Montreal, and the remainder from the Columbia River. They are disposed of in London at periodical sales.

The fur trade is prosecuted in the North-western Territories of the United States by an association called the North American Fur Company, the principal managers of which reside in New York. The company employs steamboats for ascending the rivers, which penetrate with ease to regions that could formerly be explored only through the most painful exertions in keel-boats and barges, or by small parties on horseback or on foot.

The following are the principal skins taken for the sake of the fur:—The *ermine*, called by way of pre-eminence the precious ermine, is found almost exclusively in the cold regions of Europe and Asia. The fur of the ermine is pure white throughout, with the exception of the tip of the tail, which is black; and the spotted appearance of ermine skins, by which they are peculiarly known, is produced by fastening these black tips at intervals on the skins. The *stoat* is an inferior kind of ermine. The *sable* is a native of Northern Europe and Siberia; those of the darkest colour are the most esteemed. *Martens* are found in North America as well as in Northern Asia; the American skins are generally the least valued, but many among them are rich and of a beautiful dark-brown olive colour. The *fiery fox*, so called from its brilliant red colour, is taken near the north-eastern coast of Asia, and its fur is much valued, both for its colour and fineness, in that quarter of the world. *Nutria* skins are obtained from South America, and are chiefly used by hat manufacturers as a substitute for beaver. *Sea-otter* fur, of the young animal, is of a beautiful brown colour, but when older the colour becomes jet black. The fur is exceedingly fine, soft, and close, and bears a silky gloss. *Fur-seals* are found in great numbers in the colder latitudes of the southern hemisphere. The skin of bears, foxes, beavers, racoons, badgers, minks, lynxes, musk-rats, rabbits, hares, and squirrels are procured in the higher latitudes of North America.

Furs may be classed as *felted furs* and *dressed furs*. The first include all such as are employed in hat-making, and are principally the skins of the hare, rabbit, beaver, and nutria—the latter obtained from a small animal called the coypou; but of all the American varieties those of the silver fox are the most scarce and valuable.

Furs being entirely the produce of nature, which can neither be cultivated nor increased, their value is not influenced by fashion alone, but depends materially on the larger or smaller supplies received. The weather has great influence on the quality and quantity of furs imported from all quarters of the globe; and this circumstance renders the fur trade very difficult and precarious. The quality, and consequently the price, of many furs will differ every year. Sometimes the same article will rise and fall 100, 200, and 300 per cent. in the course of twelve months—occasionally indeed in even a shorter period. Among the furs which always rank very high (though like all the others they change in value) may be specified the ermine, the Siberian sable, and the black and silver fox. These are at all times comparatively very scarce, and usually command high prices.

The term *dressed furs* is given to those furs which are retained on the original pelt, and in that state worn as garments or trimmings in the form of cloaks, tippets, cuffs, collars, &c. The fur-hunters, when they have killed a beaver or other fur-bearing animal, strip off the skin and hang it up to dry, either in the open air or in a dry and cool room. When the skins are brought to England and placed in the hands of the furrier he examines them minutely, to see that the drying has been properly effected, and the pelt in a firm state. He then washes the skin, to extract all greasiness from the fur, and gives the pelt a

sort of slight tanning or tawing, by means of alum and other ingredients. The skins are then ready to be worked up into materials for garments. In order to give the surface of the fur a uniform length and colour of fibre, it is often necessary to cut up many skins, and sew them edge to edge; for it is rarely the case that every part of the same skin is of a uniform colour.

FURTH, a town of Bavaria, in the circle of Middle Franconia, is situated in a fertile plain at the confluence of the Regnitz and the Pregnitz, about 4 miles N.W. of Nürnberg, to which it is joined by a railway. It has about 31,000 inhabitants, a large number of whom are Jews. There are several churches, one of which is Roman Catholic, and a splendid synagogue. The High Church contains one of the oldest and largest organs in Germany. The Jews have a sort of a university here, called a Talmud School, where their learned men and rabbis are educated. Fürth has also a town-hall, with a tower 215 feet high, a grammar and a superior civic school, an hospital, a theatre, &c. Independently of a brisk transit trade, Fürth is the residence of a number of small manufacturers, whose productions are looking-glasses, chandeliers, glass, sealing-wax, pocket-books, pencils, needles, spectacles, cabinet-work, turnery, clocks, jewelry, saddles and harness, locks, &c. Some cottons, caps, and stockings are also woven. There is an annual fair at Michaelmas, which lasts fourteen days.

The first railway for steam carriages in Germany was completed in 1835–36 between this town and Nürnberg, a distance of 4½ miles.

Fürth is first mentioned early in the tenth century. Gustavus Adolphus was defeated in 1632 in an attempt to carry the intrenchments of Wallenstein, in the neighbourhood of this city.

FURZE (Ulex), a genus of plants belonging to the order LEGUMINOSÆ. The species are branched evergreen shrubs, furnished with spines, and bearing yellow flowers. The calyx is two-parted, with two minute bracts at the base, and the pod is thick and few-seeded. *Ulex europæus* (common furze, gorse, and whin) is an erect evergreen shrub, with yellow flowers, which appear in greatest abundance from February to May, though in mild seasons it may be seen in blossom all the year round. It is sometimes used for hedges, for which it is well adapted. *Ulex nanus* (the dwarf or French furze) is a native of England and Scotland, also of the west of France, in poor gravelly soils, but not common on the Continent. The bracts at the base of the calyx are much smaller than in the common furze, and do not spread. *Ulex strictus* (the Irish furze) is an upright plant, seldom flowering. Its branches are soft and succulent. In size and character it stands between the two foregoing species, but is a mere variety of the common furze. *Ulex Gallii*, found in England and Ireland, differs from the common furze in the bracts being very minute, and from the dwarf furze in the wings of the corolla being longer than the keel.

FUSE, a short tube made of metal or of a tough hard wood, which is filled with a slow-burning composition and used for firing shells. For muzzle-loading guns the fuses are made with a ring of quick match at the end, which is ignited by the flash of the gun. For breechloaders, where the projectile fits more closely, the fuses are provided with detonators. The sides of a fuse are marked with two lines of numbered circles, one line having the odd and the other the even numbers. The distances thus marked are termed tenths, and before the fuse is inserted a hole is bored through one of the circles to the centre of the fuse so as to explode the shell when the fire reaches that point. The length of the fuse is regulated by the intended range of the shell or the time of its flight. Some forms of fuse are designed to explode the shell the moment it strikes the ground, and are termed percussion. Sensitive fuses are such as are made to explode the shell on its meeting with but slight resistance, while delayed-action fuses allow the projectile to bury itself and come to rest before the explosion takes place. Armour-piercing shells are often used without fuses, the heat caused by the impact being sufficient to fire the powder they contain. Fuses regulated to burn with varying rapidity are used for all kinds of purposes, both in military affairs and in carrying out blasting operations.

FU'SEL OIL, a substance continually met with in the manufacture of potato brandy, passing over in considerable quantity towards the end of the distillation. The principal constituent is amylic alcohol or hydrated oxide of amyl (C_5H_{11}). The formula is $C_5H_{12}O$. It is formed in nearly all fermentations. It is a colourless liquid, with a strong characteristic odour, and is inflammable, burning with a white smoky flame; specific gravity, 0·811; boils at 132° C. (269° Fahr.) This substance is found in the "faints" of all raw-grain distillations, and gives rise to the distressing symptoms characteristic of new whisky. It can be removed by filtration through charcoal. By long keeping, also, it undergoes some etherification, which alters its character and renders all old whisky wholesome. The odour of the fusel oil is easily recognized by allowing the spirit to evaporate on the palm of the hand. It has been used mixed with rape-oil as a substitute for sperm-oil in greasing machinery, under the name of *hydrosperm*.

FUSE'LI, HENRY, was the second son of John Caspar Fuessli, a portrait and landscape painter, and author of "Lives of the Helvetic Painters." He was born at Zürich, in Switzerland, 7th February, 1741. The elder Fuessli gave his son a classical education, and brought him up for the church. He took the degree of M.A. at Caroline College, Zürich, and entered into holy orders in 1761; but having written a pamphlet, in conjunction with Lavater, in which the conduct of an unjust magistrate was exposed, his friends deemed it prudent to oblige him to travel for a while. Having come to England he stayed here, supporting himself for a time by translating for the booksellers. In 1766 he travelled for a short time as the tutor of the eldest son of Earl Waldegrave, but threw up the charge in displeasure. He now saw Reynolds, showed him his drawings, and at once, by Reynolds' advice, devoted himself to art. He was one of the artists engaged by Boydell for his Shakspeare Gallery. In 1790 he was elected a member of the Royal Academy, of which, nine years later, he became professor of painting, and, in 1803, keeper. Boydell's Shakspeare Gallery suggested to Fuseli the idea of a similar one for Milton, which he accomplished, and exhibited in 1799, but with no pecuniary advantage. Among his literary works he edited an edition of the works of his young and illustrious friend Lavater, assisted Cowper in his translation of Homer, translated into German Lady Mary Montague's Letters, and into English Winkelmann's work on Ancient Painting and Sculpture.

His lectures contain some of the best fine-art criticism in the language. In painting he made Michael Angelo his chief study. In dreams or terrible subjects he is often grand; generally his works are characterized by superfluous energy. Many stories are told of his satirical wit upon his contemporaries. Fuseli died 15th April, 1825, and was buried in the crypt of St. Paul's Cathedral. He had altered his name from Fuessli in order to suit the Italian pronunciation.

FUSIBLE METAL, an alloy of bismuth, lead, and tin, melting below the temperature of boiling water. See BISMUTH.

FUSILIERS' were formerly soldiers in the British service whose muskets were lighter and shorter than the rest of the army; but all infantry regiments now carry the same kind of rifle.

FUSION and **FREEZING.** Nearly all solid homogeneous bodies undergo an important molecular change called fusion, liquefaction, or melting at a certain tem-

perature, which, as a rule, is constant for each substance; this temperature, above which the substance is a solid, and below which it is a liquid, is called the melting point, and less correctly (because less uniformly) the freezing point. There is usually a change of volume, which is increased in the liquid form. Water forms the most notable exception to this rule. The continued application of heat does not increase the temperature of the solid until it is all melted, and the withdrawal of heat does not decrease the temperature until it is all solidified or frozen. This temperature differs widely in different substances. The melting points of the best known metals, for instance, extend from 39° C. below zero (that of mercury, which is solidified with great difficulty) to 2600° C. (that of platinum, which is melted only by the oxyhydrogen blowpipe). The transition is generally sudden, but some metals, such as iron and platinum, become gradually softer before melting—a property which allows of welding these metals easily. The case of arsenic is peculiar, as the metal boils at the same temperature as the melting point. The following table shows the melting points of the ordinary metals:—

	Melting point.		Melting point.
Mercury,	−40° C.	Aluminium,	700° C.
Potassium,	62·5°	Silver,	1000°
Fusible metal,	93·75°	Copper,	1050°
Sodium,	96°	Cobalt,	1200°
Lithium,	180°	Iron, cast,	1200°
Magnesium,	230°	" steel,	1400°
Tin,	235°	" wrought,	1600°
Bismuth,	270°	Nickel,	1600°
Cadmium,	320°	Platinum,	2600°
Lead,	330°		
Zinc,	412°		
Arsenic,	412°		
Antimony,	425°		

Some other substances give a wider range than the metals, and recent researches point to the conclusion that temperatures may be found so high that all known solid substances would be in a state of fusion, and so low that all known liquid or gaseous substances would become solidified or frozen. The oxyhydrogen flame has no effect on lime, which is the crucible employed in melting platinum. On the other hand oxygen and hydrogen have both been liquefied, if not quite solidified, and carbonic acid in the solid state is now becoming a regular article of commerce. This substance is supplied as a liquid in strong iron vessels under a pressure of 36 atmospheres, and when allowed to escape the evaporation is so rapid that intense cold is produced, as low as −78° C., the acid becomes solid, and mercury is instantly frozen by it. As a rule great pressure as well as cold is necessary to liquefy and congeal most of the gases. The addition of a salt to water reduces the freezing point. The following are the freezing and melting points, in degrees of Fahrenheit's thermometer, of various well-known substances:—

	Deg. Fahr.
Sulphuric ether,	−46
Liquid ammonia,	−46
Nitric acid,	−45
Sulphuric acid,	−45
Brandy,	− 7
Pure hydrocyanic acid,	4
Common salt, saturated solution,	4
Sal-ammoniac, " "	8
Oil of turpentine,	14
Strong wines,	20
Rochelle salt,	21
Oil of bergamot,	23
Blood,	25
Epsom salt,	25
Nitre,	26
Vinegar,	28
Sulphate of zinc,	28
Milk,	30
Water,	32
Olive-oil,	36
Sulphur and phosphorus, equal parts,	40
Oil of anise,	50
Concentrated acetic acid,	50
Phosphorus,	108
Stearin,	109
Spermaceti,	112
Margaric acid,	134
Yellow wax,	142
White wax,	156
Sulphur,	218

Regular temperature thermometers have been recently suggested, which depend on the various melting points of mixtures of paraffin and paraffin oils.

The material used by confectioners for producing cold is a mixture of ice and common salt, which in passing from the solid to the liquid state absorbs so much heat, or in ordinary language produces so much cold, as will reduce the thermometer from the usual temperature to zero of Fahrenheit. If, however, freshly fallen snow be used instead of ice, then the fluidity is more suddenly produced, and the cold is more intense. It is found that ice or snow, though exceedingly convenient substances for the production of artificial cold, are by no means necessary to it. Any salts which dissolve rapidly in water, finely powdered, are powerful freezing mixtures.

In using all freezing mixtures of salts these must be finely powdered, brought as rapidly as possible into solution, and used in large quantity. The containing vessels must be well surrounded with felt, sawdust, charcoal, or other non conducting material.

The following are useful freezing mixtures, with the diminution of temperature which they produce:—

	Deg. Fahr.
Salt, 1 part; snow, 2 parts,	− 5
Salt, 2; ammonium chloride, 1; snow, 5,	−12
Salt, 10; snow, 24; ammonium chloride, 5; potassium nitrate, 5,	−18
Snow, 3; dilute sulphuric acid, 2,	−23
Snow, 8; hydrochloric acid, 5,	−27
Snow, 7; nitric acid, 4,	−30
Snow, 4; calcium chloride, 5,	−40
Snow, 2; calcium chloride crystals, 3,	−50
Snow, 3; fused potash, 4,	−51

These temperatures indicate degrees below zero. In most cases the exact temperature reached depends on the temperature of the substance before the freezing process.

In order to produce the congelation of water by a rapid evaporation from its own surface under the exhausted receiver of an air-pump, Sir John Leslie introduced in the receiver a shallow vessel containing highly concentrated sulphuric acid, above which was placed the vessel containing the water. The air being extracted as quickly as possible, the vapour, which, in consequence of the removal of the pressure, escaped continually from the water, was absorbed by the acid as fast as it rose; and the remainder of the water was speedily frozen. Dry potash or calcium chloride may be used instead of sulphuric acid. This principle of the production of cold by evaporation of water is illustrated in the porous water-bottles and butter-coolers in domestic use.

FUS'TIAN, a cotton fabric, similar in the mode of manufacture to velvet, having in addition to the warp and weft, common to all woven goods, a *pile*, consisting of

other threads doubled under the weft, and "thrown in" at intervals so close together that when the goods are finished the interlacing of the warp and weft is concealed by them. While in the loom, the pile forms a series of loops, which are afterwards cut and sheared; the shearing is effected by very beautiful machinery.

There are different varieties of fustians, known by the names of cotton velvets, velveteens, beaverteens, moleskins, corduroys, and cords. Different patterns are produced by different dispositions of the pile threads. Fustian is said to derive its name from Fustât, a suburb of Cairo, whence the stuff first came. It was spoken of in the middle of the sixteenth century as fustian of Naples, whence the term "fustianaunapes" ("fustian and apes").

FUS'TIC, two yellow dyes—old fustic, or bois jaune, from dyers' mulberry (*Morus tinctoria*); and young fustic, from sumach (*Rhus cotinus*). The former yields with mordants a dull yellow colour, the latter a bright yellow colour, which changes to purple by alkalies. It is much used in calico-printing.

FU'SUS. See SPINDLE-SHELL.

FUX, JOHN JOSEPH, a distinguished musician of the contrapuntal school, was born of low parentage in 1660, near Gratz in Styria, and died full of honours at Vienna in 1741, being buried at St. Stephen's. Although he was most industrious as a composer, filling all kinds of church and court musical posts, he is now probably only known by his famous work on counterpoint and composition, the "Gradus ad Parnassum" (1725), for long the acknowledged text-book on the subject. Mozart and Haydn both learnt and taught from it. It is now quite superseded; but the examples are very good, and figure in many of the ordinary manuals of counterpoint. Some of his works are printed in Prosko's "Musica Divina," and are therefore easily accessible. The esteem in which Fux was held is shown by the Emperor Charles VI. (father of Maria Theresa) sending for him his own litter because Fux was ill of the gout, that he might be present at a performance of one of his own operas.

FYRD was the name of the *land wehr*, the *militia* of our earliest ancestors, the Englishmen before the Norman Conquest. Up till that time (1066) the fyrd was the only source available for forces for the defence of the country. At first every man was enrolled; later on every freeholder was responsible for a number of men, varying with the amount of land he held. Landholders of boroughs paid fines rather than fulfil this obligation: we find Oxford paying £20 to escape sending twenty men, and Colchester commuting its fyrd for sixpence a hearth. The penalty for non-attendance when summoned (fyrdwite) was forfeiture and a fine of 120*s.*; for a landless man, 60*s.*; a CEORL, 30*s.* Desertion also carried heavy punishment. After the Conquest the fyrd existed side by side with the *feudal array* proper: in keeping with his usual and wise course the Conqueror declined to supersede or to distrust a national arrangement. For defensive purposes the fyrd was good, but for offensive operations, especially if things went amiss, it did not do well, having an irresistible tendency to dissolve and melt away homewards as soon as the battle was over.

G

G. This letter is the seventh of the Latin alphabet. In the Greek alphabet its place is supplied by *z* (zeta), *g* (gamma) being the third letter in that alphabet. The sound of *g* in both Latin and Greek was hard (as in our word *get*), except the double *g* in Greek, when the first *g* took the sound of *ng*, as *aggelos*, a messenger, pronounced *ang-gelos*. If, as seems probable, the sound of the Greek letter zeta was the same as that of the consonantal sound at the beginning of the word *judge*, it may perhaps be inferred that the hissing sound given now to one pronunciation of the letter *g* existed in some dialect of ancient Italy. The sound is familiar to the modern Italian.

The sound of the letter *g* in the English language is threefold. Before *a*, *o*, and *u*, and occasionally before *i* and *e*, it is the sonant mute of the palatal series, and this is the original sound of the Old English *g*. In Old English it always sounds thus, even before *e*, *i*, and *y*, as in *gifan* (to give), *geten* (to get), *gyrdel* (a girdle), &c. The other sound, which it now usually has before *i*, *e*, and *y*, is one of the sonants of the sibilant series, and is also represented by the letter *j*, as pronounced by the English. The sibilant sound is written in Italian by two letters, *gi*, as *Giacomo*, Jacob, or by *gg*, as *oggi*, to-day. The twofold nature of the sound corresponds to the double sound of the letter c. A third sound is partly expressed by *g*, though it really at first sight would seem to have little to do with that letter. It is the sonant nasal of the palatal series expressed by the letters *ng*, and produced by dropping the veil of the palate, which in ordinary utterance closes the passage from the pharynx into the nose. In this way the intonated current of the sonant mute *g* is allowed entrance to the nose and exit there, and the result is its conversion into a nasal, as in *singing*. We are here approaching the vowel sounds.

The palatal *g* is liable to many changes in different dialects or languages

1. *G* and *k* are convertible. Thus the Greek and Latin forms *genu*, γονυ; *gen*, γεν, as in *gen-us*, γεν-ος; *gno*, γνω, as in *gno-sco*, γι γνω σκω, severally correspond to the German and English *knie*, *knee*; *kind*, *kin*; *kenn-en*, *know*. So much is this the case that the Romans at one time abandoned the *k* altogether, using only c, which was their way of writing *g*. Their *a b c d* was therefore really *a b g d*, as with the Greeks. When about the third century B.C. they renewed the *k*-sound they allowed their c to take this meaning instead of *g*, which it had before, and their *a b c d* became really *a b k d*. An altered C (G) was invented for the *g*-sound.

2. *G* and an aspirated guttural: as, Greek, χην; German, *gans*; English, *goose* and *gander*. There can be no doubt as to the connection between the Greek χθες, the Latin *hes-ternus*, the German *ges-tern*, and the English *yester-day*. The close connection of the two sounds may also be seen in the pronunciation of the final *g* in high German like *ch*, *Ludwig*, &c.

3. *G* and *h*. As the letter *h*, when pronounced, is only a weak aspirate, this interchange strictly belongs to the last head.

4. *G* often disappears: first, at the beginning of a word, as in the Latin *anser*, a goose, compared with the forms given above, and in the modern English *if*, *enough*, compared with the Old English *gif*, *genoh*. Many examples of this occur in the now poetical participles of the English language commencing with a *y*, as *yclept*, *yclad*, &c.; also in *ago* for *agone*; in all of which the fuller form began with *ge*, as is still seen in German. The loss of *g* is very common before *l* and *n*, as Eng. *like*, Old Eng. *gelic*, Germ. *gleich*; Lat. *nosco*, *nascor*, from *gnosco*, *gnascor*; *disdain*, from Lat. *disdignare*. Secondly, in the middle of words between vowels, as in French words derived from the Latin; as *legere*, *lire*, read; *magister*, *maistre*, master; *Ligeris*, *Loire*, &c.; also in words coming down from Old

English, as *nægel, nail; segel, sail; regn, rain*, &c. In such cases the vowel is generally lengthened. Lastly, at the end of words, as *secgan, say; mæg, may; dæg, day:* here again the syllable is strengthened.

5. *G* and *y* are convertible; as *yester-day*, compared with the Old English *geostra-dæg; yawn* with *ganian; yellow* with *geolo*. So also *yard* and *garden;* and *yate*, a dialectic variety of *gate*.

6. *G* with *gu* and *w*. In the Latin language there coexist the forms *tinguo, tingo; unguo, ungo; urgueo, urgeo*, &c. In the French language *gu* is presented to the eye, but *g* to the ear, in *guerre, guêpe*, &c.; in English we have *war, wasp*, &c. So from the Old English *dagian, fugol, mearg, lagu, gealga*, we get our modern English *dawn, fowl, marrow, law, gallows;* and from the Old French *gauffre* we get *wafer*. Chaucer gets *wastel* (cake) from *gâteau*, as in his word for cake, *wastel-brede*. In many instances we get the Old English *w*-form and the French *gu*-form together. Thus *wise* and *guise, warranty* and *guarantee, wile* and *guile*, &c.

7. *G* and *b*. This is generally confined to those cases at the beginning of words when an *r* or *l* follows, as in the Æolic forms, **γλεφαρον, γληχων, γαλανος**, in place of **βλεφαρον, βληχων, βαλανος.**

8. *G* and *d:* as **δη-μητηρ** for **γη-μητηρ**. This change, as in the last case, is common before *l;* hence the Latin *dulcis* by the side of the Greek **γλυκυς.**

9. The guttural *g* and the sibilant *g*. The hard *g* belongs to Europe, the *j* sound to Asia. Thus *reg* (rex), a king, is in the East *raj-sah*. But we have also home examples, as *edge*, from Old English *ecg; bridge*, from *brycg*, Scotch *brig*, &c.

10. The sibilant *g* and *di* or *bi* before a vowel; as Lat. *hodie*, Italian *oggi; cambiare, changer*.

11. *G* appears to attach itself to the letter *r* at the end of roots; as *mergo spargo*, compared respectively with the Latin *mare* and the Greek **σπειρω**. This outgrowth corresponds to the addition of *d* at the end of roots ending in *n*, as *sound*, Middle English *soun*, French *son*, Lat. *son-um*.

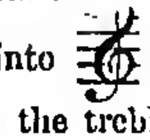
12. *G* has crept into several words, as *foreign* for forain, *sovereign* for sovran, *impregnable* for imprenable, &c.

G, in music, is the seventh and last letter in the musical alphabet, if we do not count the altogether irregular H for B♭ of the Germans. It is the seventh note in the scale of the ancient Greeks in the Hypodorian mode [see GREEK MUSICAL SYTSEM], and the fifth note of our "natural" or typical scale, that of C. The French and Italians accordingly call it *sol*, the fifth of the well-known Sol-fa syllables which they use to designate notes in preference to letters. This is not to be confused with the Tonic Sol-fa use of the syllable *sol*, as the latter means simply "fifth of the scale," whatever scale it may be. G♭ in French and Italian is *Sol bemol, bemolle*; G♯ is *Sol dièse, diesis*. In German G, G♭, G♯ are respectively *G, Ges, Gis;* and the keys of G major and G minor are in German *G-dur* and *G-moll*.

G was the keynote of the Hyperdorian mode of the ancient Greek musical system, and of the Mixo-Lydian mode of the mediæval church-system. See MODES, ECCLESIASTICAL.

In modern music the key of G major has one sharp in its signature (F♯); and that of G minor two flats (B♭, E♭); G♭ major has six flats (every note flat but F); G♯ is not used as a major keynote, as it demands every note sharpened, and even one double sharp (Fx). Its place is taken as a keynote by the enharmonic A♭. G♯ minor is, however, necessary as a relative minor to B major, and is so used; but it is an awkward key (G♯, A♯, B, C♯, D♯, E, Fx, G♯). The relative major of G minor is B♭ major; and the relative minors of G major and G♭ major are E minor and E♭ minor.

G is the lowest string of the violin and the second string of the viola (*g*). It is also (at an octave lower, G) the second string of the violoncello and the top string of the contrabasso in both the three-stringed and four-stringed instruments. It is therefore a favourite key for brilliant orchestral works, since there are so many open notes of great resonance on the strings. It is not, however, the natural key of any of the wind instruments, except one variety of trombones, the bass trombone.

The letter G converted into  becomes the familiar "G clef," and as such rules the treble stave. This stave is sometimes carelessly called the G clef ("tenor part in the G clef," &c.) The curl of the clef sign must always embrace the second line of the treble stave. There are other and less used G-clef staves however. [See CLEF.] It also gives its name (in Greek) to the scale itself, the word *gamut* being nothing but *gamma-ut—i.e. gamma* (G) taken as the *ut* or keynote.

GAB'BRO or **EU'PHOTIDE** is a granitic rock typically composed of a granular crystalline aggregate of labradorite and diallage. In some varieties of this rock the felspar is replaced by saussurite, which, when associated with smaragdite or diallage, Dana distinguishes as *euphotide;* while a rock composed of foliated pyroxene (like hypersthene) and labradorite (andesite) or anorthite, he calls *norite*. When hypersthene replaces the diallage the rock is called *hypersthenite*.

Gabbro is one of the basic igneous rocks, that is, contains less than about 60 per cent. of silica. It has the same ultimate chemical composition as basalt and tachylyte, which are considered to be respectively its lava and glassy forms, the differences in texture being due to the different conditions under which they cooled—gabbro having cooled slowly at a great depth, and having a greater specific gravity than the other two, which solidified more rapidly near the surface. Gabbro is an eruptive rock; it occurs in bosses or intrusive masses, dykes, or sheets. Many accessory minerals occur in it, perhaps one of the most interesting being the fine spicules of native iron found in some gabbros of the west of Scotland.

GA'BII, one of the most important towns of ancient Latium, about 12 miles from Rome. The state of decay into which it fell gave rise to a proverb expressive of desolation. For a time, under the Roman emperors, it received new life from the fame of its mineral waters; but although bishops of Gabii continue to be mentioned until the ninth century, scarcely anything is heard of it after the third century. A ruined temple still stands on its site.

GA'BION, a hollow cylinder of wicker-work resembling a basket, but having no bottom. It is formed by planting slender stakes vertically in the ground, at intervals from each other, on the circumference of a circle, and interweaving with them osiers or other flexible twigs.

The most usual kind of gabion is about 2 feet in diameter and 2 feet 9 inches in height, but the stakes, whose extremities are pointed, project beyond the basket-work about 3 or 4 inches at each end. Such gabions are used during a siege in executing trenches by the process of sapping.

Gabions of the same kind are sometimes used to form a revetement for the interior of a battery, being then placed on end in two or more horizontal rows, one above the other, and leaning against the mass of earth. Four or five gabions line each side or cheek of the embrasure at the neck of the latter.

A *gabionnade* is any lodgment consisting of a parapet hastily formed by placing on the ground a row of gabions, and filling them with earth obtained by digging a trench parallel to the line, in their rear.

GABLE, the triangular part of the end wall of a building, between the top of the side-walls and the slopes of the roof. The entire wall of the building of which the gable is the top part is called the gable-end. In classical

architecture the term is not used, the place of the gable being occupied by the pediment; but it is one of the most common and characteristic features of Gothic architecture. The small gable-like ornaments over niches, on buttresses, &c., are called gablets, and are introduced in great variety along with tracery and other enrichments.

GABOON' RIVER, or **RIO DE GABAO,** a river in Western Africa, which rises in the Crystal Mountains, and running almost parallel to the coast, about 100 miles distant from it, flows into the Atlantic at 0° 30′ N. lat., and 9° 10′ E. lon. Its length is about 300 miles, and its mouth forms a large bay. The tide flows nearly the whole course, and the river is deep. The country traversed by the Gaboon yields annually an immense quantity of ivory, besides ebony, dyewoods, and copal. At the mouth of the river the French erected a military and commercial establishment in 1842, and in the following year an American mission was founded at Baraka, 8 miles up the river, which still continues in operation. In 1845 an establishment called Le Plateau was founded at Libreville and attained to some importance, but in 1871 it was practically abandoned by the French with the exception of their still using it as a coaling station. The region of the Gaboon River is the abode of the gorilla, and it was made well known in Europe by the travels of M. du Chaillu and Mr. Winwood Reade. The language of the M'pongwa, one of the tribes of the country, is thought likely to become the dominant tongue of the coast. It possesses great flexibility and descriptive power.

GA'BRIEL (Heb., the man of God, or the strong one of God), the name, according to the Jews, of one of the seven archangels. The name, which is not in itself distinctive, is used as a proper name in the Book of Daniel, viii. 16; ix. 21; and by St. Luke, i. 19, 26. He is represented by the rabbis as the angel of death and the guardian of the souls of the people of Israel. The Talmud speaks of him as the spirit presiding over the lightning and thunder, and over fire—one legend ascribing the burning of the temple to him at the taking of Jerusalem by the soldiers of Nebuchadnezzar.

By the Mohammedans he is held in even greater reverence than by the Jews. According to their traditions he is the chief of the angels of heaven, is the spirit of truth, and as such dictated the Koran to Mohammed.

GABRIE'LI, ANDREA (1510–86), a pupil of the famous early composer Willaert, was also distinguished among the early contrapuntal writers, and was organist of St. Mark's, Venice. Proske's "Musica Divina," a collection of the finest works of the earliest musicians, has several excellent motets by Gabrieli. His nephew and pupil, Giovanni (1557–1613), was almost equally celebrated. Schütz the composer and Prætorius the theorist were his pupils. Both uncle and nephew were successively the centre of an important school of pupils; and Winterfeld, in a most interesting work ("J. Gabrieli und sein zeit-alter") has used their great position as the central theme for a consideration of music at the close of the sixteenth century.

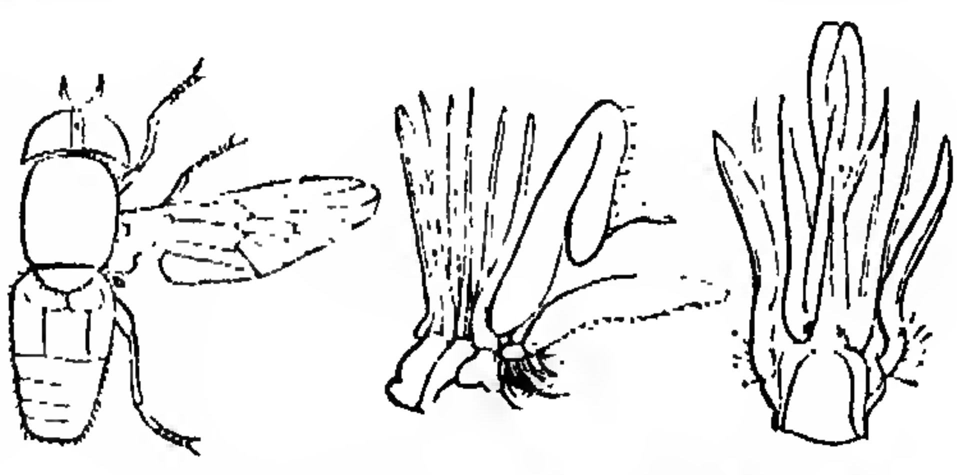
GADDI, GADDO, the friend of Cimabue, was born at Florence, 1249. He executed the mosaic of the "Coronation of the Madonna," in the Duomo, which is still extant, and which obtained for him a reputation all over Italy, and important commissions from Clement V. at Rome. He died in 1312.

GADDI, TADDEO, was a more able man than his father, after whose death he lived twenty-four years with Giotto, who was his godfather. He was the most distinguished of Giotto's scholars. His best remaining works are perhaps the frescos in the church of Santa Croce at Florence. Taddeo was likewise a distinguished architect; he built the Ponte Vecchio in 1345, and this still remains one of the ornaments of the town. He amassed great wealth and established a family, and the Gaddi have been for many centuries one of the most distinguished houses of Florence. It is not known when Taddeo died; he was living in 1366. He was buried near his father in Santa Croce.

His son Angelo was a painter of less merit; some of his work is in Santa Croce, and is sometimes confused with that of his father.

GADES. See CADIZ.

GAD'FLY is the common name of the species of the Tabanidæ, a family of insects belonging to the order DIPTERA. The species of this family are also called breeze-flies, horse-flies, and clegs. In this family the body is large and broad, and furnished with large strong wings. The head is somewhat flattened, and furnished with a formidable proboscis, which incloses piercing lancets, and is terminated by two sucking lobes. The proboscis is shorter and the lancets are less in number in the male. The antennæ are apparently three-jointed, but the last joint really consists of several. Their wings, which are extended horizontally and provided with strong muscles, are marked by a greater number of nervures than other families of this order. The Ox Gadfly (*Tabanus bovinus*)



Tabanus bovinus, with front and lateral view of the parts of the mouth.

is the type of the family. When full grown it is a large pale brown fly, marked on the back by a series of whitish triangular spots. The egg is deposited in the earth. The larva is a dusky yellow worm, varied by transverse blackish rings. All the species are exceedingly troublesome to the different animals attacked by them. They are chiefly met with in pasture fields bounded by woods. The season at which they bite most freely is about mid-day in the middle of summer. When on the wing they make a loud buzzing noise, hence the name breeze-flies. The very sound of their approach so alarms whole herds of cattle that they may be seen rushing off headlong, in order to get away from their enemies. The females alone are blood-suckers. The ox gadfly, or common gadfly or breeze-fly, attacks oxen and sucks their blood by piercing the skin. The wound made by it causes great pain. This is the gadfly which tortured the transformed Io. Eight or nine species of the genus Chrysops are known, of which two only inhabit this country. All are blood-suckers. One species, the Golden Eye (*Chrysops cæcutiens*), by no means uncommon, gives considerable pain by the insertion of its sharp proboscis into the skin, even through the sleeve of a coat. The other species is the *Chrysops relictus*. Both are remarkable for the brilliancy of their large eyes. To this genus that of Hæmatopota is closely allied. Four species are found in Great Britain. The species of these genera are often called CLEGS. In the remaining genus Pangonia, found in the south of Europe, the proboscis is often very long.

The name gadfly probably means the fly that makes the cattle "gadde up and down with stinging them." Another etymology is the goadfly. The name is also given to species of the family Œstridæ (BOTFLY).

GAD'IDÆ is a family of fishes of which the common COD (*Gadus morrhua*) is the type. The Gadidæ are second in importance to no family of fishes, the fisheries

established for their capture yielding a great quantity of nutritive food, and being the means of training up many thousands of able and hardy seamen. The members of the family are more or less elongated, generally with tumid bellies. The ventral fins are jugular, have seldom much spread, and are sometimes mere filaments; the dorsals are one, two, or three in number, all without spinous rays; the caudal fin is generally distinct from the dorsal and anal fins, but when united the dorsal has a separate portion in front; the scales are cycloid, small, and soft. Card-like or rasp-like patches of teeth cover the jaws, front of the vomer, and occasionally the palatines. The branchiostegals are seven in number; the air-bladder is large and often indented, but has no pneumatic duct. The stomach is capacious, with a sac-like projection below the pylorus, and the pyloric cæca are numerous. Most of the Gadidæ live at the surface near the shore. They are confined to the temperate zones and warmer parts of the frigid zones. The deep-sea forms have a wider range. Only two or three species inhabit fresh waters. The Gadidæ date from the Eocene period. The most important genera included in this family are:—Gadus (cod, haddock, &c.), Merluccius (hake), Pseudophycis, Phycis (forked hake), Halopophyrus, Lota (burbot), Malva (ling), Motella (rockling), Raniceps (tadpole hake), Brosmius (torsk). The Gadidæ belong to the ANACANTHINI, an order of Teleostei.

GAD'WALL (*Anas strepera*) is the common name of a DUCK which, though an occasional visitant, is rare in Britain. It is common in the north of Europe, Asia, and America. The length of the gadwall is about 19 inches. Its bill is 2 inches long, of equal breadth throughout, depressed, and with very fine, distinct, and numerous laminæ. The tail is wedge-shaped, the head small, and the back flat. The head and neck are gray, with brown spots; the breast and back marked by black and white lines. The lesser wing-coverts are chestnut; the greater wing-coverts, rump, and coverts of the tail black. The greater quills are dusky, three of the secondaries having the inner web white. The tail is short, and consists of sixteen pointed feathers, of a reddish-gray colour, and white at the tips. The two sexes agree very nearly in colouration. The gadwall breeds in marshes. Owing to the draining and reclaiming of such localities their numbers are on the decrease in this country. Recently in some parts of the country the protection afforded them has been attended with satisfactory results. The gadwall is much esteemed for the table.

GÆA, in Hesiod's cosmogony, was the daughter of Chaos. She, the broad Earth (Ge), arose with Love, Night, and Gloom from the primeval shapelessness. From the Earth sprang the Heaven (the sky, Ouranos) and the Ocean (Pontos). Gæa eventually married Ouranos, and from them were born the twelve TITANS, the CYCLOPES, and the three 100-handed giants, Briareos, Kottos, and Gyes.

Ouranos, well-knowing that his children should supplant him, would have killed them as they were born, but Gæa concealed them in her bosom (in the Earth), and at last, worn out by the anxiety, she gave the youngest-born, Kronos, a sickle wherewith to avenge and for ever stay the injustice of the unnatural father. Kronos mutilated his father, and from the blood which fell from the wound upon the Earth sprang up the Furies, the Giants, and Nymphs.

Gæa has many attributes of Rhea, and more still of Demeter; and it seems likely that several tribes, each with its great gods, coalesced in the early times of prehistoric Greece, and that the generations of the gods were invented to account for the duplicate divinities. Gæa's worship was most extensive in Greece and Rome (*Tellus* is the Latin name), and was frequently united with that of the infernal deities.

GAELIC. Although the language spoken by the Scottish Highlanders is familiarly known among the Lowlanders by the name of the *Erse*, or, according to the more usual pronunciation, the *Ersh*, that is, plainly, the Eirish or Irish, the people themselves are never called by that name. Among the Highlanders the name Erse is unknown. They call themselves only the *Gàidheil*, also sometimes written and always pronounced *Gàël*; and their language the *Gàidhlig*, pronounced *Gàëlig*, or *Gaelic;* and their country *Gaeltachd*, which the Romans softened into *Caledonia*, or the district of the *Gael*. The name *Gaelic* is also in familiar use among the Lowlanders as that of the language. Further, the Irish are also known to the Scottish Highlanders as *Gael*. The latter call themselves *Gàëil Albannach*, or the Gael of Albin, and call the Irish *Gàëil Erionnach*, or the Gael of Erin. The Irish also call themselves the *Gadhel*, or *Gael*, and their language the *Gaoidheilg*. Finally, the Welsh call the Irish *Gwyddel*, which is evidently the same word with *Gadhel* or *Gael*.

The *Galli* of the Roman writers, and the *Galatai* of the Greek, are the same with the *Keltai* sometimes spoken of by the ancients as a general name for the Gauls, sometimes as the name of only a certain portion of the Gauls. Modern usage limits Gauls to the settlers in France, and uses Celts as the wider signification. But that the colony from Gaul possessed themselves at first of that part of Britain which was next to their own country, and spreading northward by degrees, as they increased in number, peopled the whole island, and that some adventurers passing over from those parts of Britain that are within sight of Ireland were the founders of the Irish nation, is now generally admitted, and is a more probable story than the idle fables of Milesian and Gallician colonies.

The Celtic tongues are divided into the Cymric and the Gaelic. Probably the Gaels represent the first wave of invasion, spreading over our country, then occupied by an ancient race called Firbolg in the legendary history of Ireland, and Silures by the Romans who found them in South Wales. These "neolithic" men were a short, dark, foreign-looking race, and are yet clearly traceable by the traveller in certain districts of South Wales, of Ireland, and of the Highlands. They seem to be of the kin of the south of France folk, the Ligurians, and of the aboriginal North Spanish people, the dwellers by Ebro, the Iberians. The oval-headed Celts are very different. Their chief division, the Gaels, has two branches; the *Picts* (painted people—*Picti*, a Roman nickname), fair-skinned, large-limbed, red-haired, living in the interior of Britain and in the Highlands; and the *Scots*, a fair-skinned but brown-haired race living in Ulster and in the west of Scotland, and the originals of the "Milesians" of the fabulous history. The lesser division, as far as Britain is concerned, is the Cymry, divided into the Welsh and the Cornish. These, and not the Gaels, were the closest to the Gauls, who form a third and later wave of the Celtic invasion of Britain. The Gauls pressed on the Cymry and drove them westward, just as the latter had driven the Gaels; Southern Britain was rather Gaulish than Cymric therefore, Western Britain was Cymric, Northern Britain and Ireland were Gaelic.

Though the Gaelic cannot boast of many volumes of literary and scientific works, for these are generally confined to the language of court in every country, yet the Highlanders may point to individuals who have produced works in poetry, grammar, and philosophy in their native language which would not disgrace the most learned and polished nation.

One of the best publications on the subject of the Gael, in English, is "The Highlanders of Scotland, their Origin, History, and Antiquities," by W. F. Skene (two vols. 8vo, London, 1837), being an essay to which a prize had been awarded by the Highland Society of London. Mr. Skene's views and reasonings are of very considerable ingenuity; and whatever may be thought of the part of it which

relates to the origin of the Gael, the work is undoubtedly in other respects one of the most important contributions to early Scottish history that modern research has furnished. Irish Gaelic has memorials going back to the end of the eighth century. The oldest poetry in the Scottish Gaelic is preserved in the "Dean of Lismore's Book," written between 1511 and 1551, by Sir James Macgregor, and now in the Advocates' Library at Edinburgh. Selections from it were published at Edinburgh in 1862. The poems forming the epic of Ossian, which have splendid merits of their own, falsely alleged to be correct translations of Gaelic originals by Macpherson, are undoubtedly imitations of fine poems now lost. It is to be deplored that Macpherson did not avow his poems to be imitations, and make known instead of concealing his Gaelic models.

An account of most of the older books printed in the Scottish Gaelic will be found in Reid's "Bibliotheca Scoto-Celtica" (Glasgow, 1832); but a great number has issued from the Gaelic press since. One of the best of the latter is an edition of "Bunyan's Works" (Mackenzie, Glasgow, 1871), with illustrative notes, translated by Dr. C. R. MacGillivray.

Though English has made great encroachments upon the Gaelic of late, by steamboats, railways, and the telegraph, the language is more tenacious of life than many people imagine, and at the census of 1881 an attempt was made to ascertain the numbers of the population in Scotland who in each locality were "Gaelic speaking"—or in the habit of making colloquial use of the Gaelic language. The total number was found to be 231,591, or 6·20 per cent. of the entire population. The largest proportionate numbers were in Argyle, Inverness, and Ross and Cromarty, where they amounted respectively to 60, 70, and 71 per cent. In Bute, Nairnshire, Perthshire, and Caithness the numbers are by no means insignificant when contrasted with the population, but in the other twenty-five Scotch counties the speakers do not amount to 5 per cent. of the total number of inhabitants.

GAE'TA (the ancient *Cajeta*), a strongly fortified town of Italy, in the province of Caserta, is situated on a lofty promontory which projects into the Mediterranean, and forms one side of the Gulf of Gaeta (the ancient *Sinus Formianus*), which rivals in beauty of scenery the neighbouring Bay of Naples. Gaeta, with its suburbs, has a population of 17,500. It has a harbour which is one of the safest on the coast and has 15 feet of water, and it carries on some trade by sea. Among the remains of antiquity are the circular monument called Torre di Orlando, which is the mausoleum of L. Munatius Plancus, and another tower called Latratina, which was once part of a temple. In the cathedral is a baptismal vase of Parian marble from the ruins of Formiæ, which had formerly been an altar to Bacchus. Pope Pius IX. sought an asylum here in 1848. Cajeta is very ancient. Virgil says it derived its name from the nurse of Æneas buried in it:—

> "Tu quoque littoribus nostris, Æneia nutrix,
> Æternam moriens famam, Caiota, dedisti."
>
> —*Æneid*, vii. 1.

It became the residence of many opulent patrician families of Rome; and Cicero was put to death, by order of Antony, in its immediate vicinity. After the fall of the Western Empire it had a republican form of government, at the head of which, however, was placed a duke acknowledging the temporal supremacy of the pope. It coined its own money till 1191; in 1435 it was taken by Alphonso V. of Aragon. In modern times it has been repeatedly besieged. The fortress surrendered to the Garibaldians and Sardinia in the Italian revolution, on 13th February, 1861. It was the last place held by the Neapolitans.

GAFF, a sort of spar or pole, used in small ships to extend the upper edge of the mizzen, and of those sail (fore-and-aft sails) whose foremost edge is joined to the mast by hoops or lacings, and which are extended by a boom below, as the mainsail of a cutter. The gaff itself ends in a stout fork, the arms of which partly embrace the mast.

GAIN'AGE, a word mentioned in Magna Carta, c. 14, meaning the plough-tackle, or implements of industry, which term in the feudal age was applied to the *gain* or profit of tilled or cultivated land, of which an estimate was taken by the lord.

GAINS'BOROUGH, an ancient market-town and seaport of England, in the county of Lincoln, is situated on the eastern bank of the river Trent, which is here crossed by a fine stone bridge, 144 miles from London by the Great Northern and Manchester, Sheffield, and Lincolnshire railways. The town contains several churches, Congregational, Wesleyan, Primitive, Old and New Connection, Free Methodist, Friends, Unitarian, and Roman Catholic chapels, a town-hall, and the Old Hall or Manor House, supposed to have been partly built by John of Gaunt, and now used as a corn exchange and assembly rooms. The town is not well built, and owing to its low site often suffers from inundations. A large business is carried on in the seed and oil crushing, about 80,000 quarters of linseed being made yearly into oil and cake. Extensive malt kilns, breweries, flax mills, shipbuilding yards, rope walks, tobacco manufactories, timber yards, and cooperages furnish employment for the inhabitants. Gainsborough has a trade with the Baltic, and also coastwise. By means of the Trent, which falls into the Humber about 20 miles below the town, vessels of 200 tons burden can come up to the wharves, and the town has inland communication by canals, and a railway extends to Great Grimsby. The population in 1881 was 10,979.

GAINS'BOROUGH, THOMAS, born in 1727 at Sudbury in Suffolk, was one of the most eminent English landscape painters of the last century. His father was a woollen crape maker of respectable birth and position, and it was under the encouragement of his mother, who had considerable ability in flower painting, that his talent with the pencil so early developed itself. He received little school education, but in the woods of Suffolk he acquired that relish for and knowledge of the beauties of quiet nature for which his early pictures are so peculiarly distinguished. He had painted several landscapes before he was fifteen years of age, when he was sent to London. There he was for some time with Mr. Gravelot the engraver and Hayman the painter, with whom he did not remain long, but setting up as a portrait painter supported himself till, at the age of nineteen, he married a young lady who had a fortune of £200 per annum. On his marriage he went to Ipswich, where he resided till 1758, when he removed to Bath. Here his reputation as a portrait painter rapidly increased, and he was able to command a highly profitable price for his pictures. It was while in Bath that he painted his portraits of Sterne, Quin, and Garrick. He removed in 1774 to London; and having painted portraits of some of the royal family, which were much admired, he soon acquired extensive practice and proportionate emolument. His landscapes, however, though their beauty was acknowledged, did not sell as well as his portraits. He ceased exhibiting at the Royal Academy, of which he was one of the thirty-six original members, in 1784, owing to his dissatisfaction with the hanging of one of his pictures. Among his most celebrated works are his "Duchess of Devonshire," "The Blue Boy," "Mrs. Siddons," "The Cottage Door," "The Market Cart," and "The Sea-shore." He died in August, 1788. His fame chiefly rests on his landscapes. Reynolds said of him, "that, if ever this nation should produce genius sufficient to acquire to us the honourable distinction of an English school, the name of Gainsborough will be transmitted to posterity as one of the very first of that rising name."

GAIUS, a Roman jurist, is supposed to have lived in the time of Antoninus Pius, and also in that of M. Aurelius and Commodus. He belonged to the school or sect of the Sabiniani; and this is all that we know of him. Though he was a voluminous writer, and several of his works are excerpted in the Digest, he is never quoted by any of the jurists who are posterior to him; at least, not in any of the excerpts from those jurists which are contained in the Digest. A list of his works is given in the Florentine Index. Of these works the principal are the thirty-two books "Ad Edictum Provinciale," the ten books "Ad Edictum Urbicum," the seven books of Aurea, and the four books of Institutiones. The number of excerpts from Gaius in the Digest is 535. The Institutiones of Gaius formed the groundwork of the Institutiones of Justinian; and the discovery of the original work of Gaius is one of the most valuable additions made to our knowledge of the Roman law since it has been cultivated in Western Europe. In the library of the Chapter of Verona there is a palimpsest MS., that is, a MS. from which the original writing has been obliterated to make room for something else. This MS., now called No. XIII., originally contained the Institutiones of Gaius, which had been rubbed out to receive the letters of St. Jerome. Niebuhr deciphered the original writing on the ninety-seventh leaf of the MS., which he easily recognized to be the work of a Roman jurist, and Savigny pronounced the leaf to belong to the Institutiones of Gaius. By the industry of the German scholars, all but about one-tenth of the text of Gaius has been recovered. The work of Gaius was intended to be used as an elementary introduction to the study of the Roman law, and it was in great repute until the composition of the Institutiones of Justinian.

GALA WATER, a river of Scotland, which joins the Tweed near Abbotsford, after a course in a S.S.E. direction of 21 miles from its source among the Moorfoot Hills, in the county of Edinburgh. It is renowned in song for its rural scenery, but towards its mouth loses much of its attractions by the diversion of its water to supply water power.

GALA'GO is a genus of LEMURS (Lemuridæ), the type of a subfamily Galaginæ. The galagos are elegant squirrel-like creatures, with rounded heads, large eyes, large membranous ears, and long tails, which are often bushy. They differ from the typical lemurs (Lemurinæ) in the elongation of the tarsal portion of the foot. In dentition they agree with the Lemurinæ. Like them they are nocturnal animals, living among the branches of the forests, where they prey upon small birds and insects. Fruits also constitute a portion of their nourishment. The species of the genus Galago differ from the typical lemurs in being distributed widely in the African continent, and not confined to Madagascar. The Senegal Galago (*Galago senegalensis*), described by Geoffroy in 1796, was the earliest known species of this genus. It is an elegant little creature, rather larger than a squirrel, of a gray colour, with a reddish tinge on some parts, and with the lower surface paler or whitish. It inhabits a considerable portion of the African continent, occurring in Senegal, Kaffraria, Abyssinia, and Mozambique. It was originally discovered in the first-mentioned locality by the celebrated Adanson, who describes its habits as intermediate between those of the monkeys and squirrels. It appears from the statements of the eminent French voyager and of later observers, that the galagos principally inhabit the large forests of acacias which furnish the gum-arabic of commerce, and that the Moors who bring them down from their native haunts give them the name of gum animals, and declare that they feed upon that substance. It appears, indeed, that they will eat gum when offered to them; but they show a very decided preference for insect food, those which have been observed in captivity being always on the watch for insects, exhibiting considerable excitement when they only hear the sounds produced by these animals, and seizing upon any unlucky victim that may come within their reach with the greatest avidity. In their native haunts they display great agility upon the trees, among the branches of which they are always sporting at night, springing suddenly upon their insect prey with a velocity greatly aided by the length of their hinder limbs. They nestle in holes of the trunks of trees, which they line with soft beds of grass and herbage for the reception of their young.

Several other species of the genus Galago are known, the largest of which, *Galago crassicaudatus*, is about the size of a cat, and is furnished with a great bushy tail some inches longer than the body. Galago is the genus Otolicnus of some authors. The only other genus of the subfamily Galaginæ is Chirogaleus. This genus is distinguished from Galago by the fact that the third upper premolar is very much smaller than the first molar and has only one external cusp, while in Galago the same tooth has two large external cusps, and nearly equals the first molar in size. The species of this genus are all small animals, and are confined to the island of Madagascar. In their general habits they resemble the galagos. Some of these animals, however, are remarkable for their habit of hibernation, or more correctly æstivation, passing the hot dry season in a state of torpidity. Like all hibernating animals they accumulate within their bodies an immense store of fat before retiring for their long sleep. In these lemurs the fat is stored up chiefly in their tails.

GAL'ANGAL is usually supposed to have been introduced by the Arabs, but it was previously mentioned by Aetius. The plant which yielded this root was long unknown, and it was supposed to be that of pepper, of an iris, of *Acorus calamus*, or to be the Acorus of the ancients. *Kæmpferia galanga* was so called from its aromatic roots having been supposed to be the true galangal. The tubers of *Cyperus longus* were sometimes substituted, and called English galangal. Two kinds, the large and the small galangal, are described.

The greater galangal is the produce of a plant, the *Galanga major* of Rumphius, which is the *Alpinia Galanga* of Willdenow, and a native of the Malayan Archipelago. The roots, perennial and tuberous, like those of the ginger, are identical with the *Galanga major* of the shops. The lesser galangal is the produce of *Alpinia officinarum*, a native of the south of China, and of the island of Hainan. It is the variety of the drug which is now seen in the market, the greater galangal only occasionally being met with. Both are aromatic stimulants like ginger, but the lesser galangal is more valuable than the other. The drug is used principally in Russia and India as a spice and medicine. In Russia it is used to flavour the liqueur called "nastoika" and also vinegar. Alpinia belongs to the order SCITAMINEÆ, and is closely allied to Zingiber (ginger), and Elettaria (cardamom).

GALAPA'GOS ISLANDS are a group of islands in the Pacific, which lie between 1° N. lat. and 2° S. lat., and 89° and 92° W. lon. They are thirteen in number, the largest being Albemarle Island, which is 60 miles in length and about 15 in breadth. The highest part is 4000 feet above the sea. Charles Island, now called La Floriana, is 20 miles long and about 15 wide.

The Galapagos Islands are of volcanic origin, and consist of enormous masses of lava rising abruptly from an almost fathomless sea. Along the shores nothing but heaps of broken lava meet the eye, but in the interior valleys and plains of moderate extent occur, which are covered with shrubs, especially the prickly pear. Though so near the equator the climate is tempered by cold currents from the Antarctic Sea. The islands are uninhabited, but are visited for the very large turtles which frequent their shores. Hence the name *Galapago*, the Spanish for tortoise. The

most remarkable fact in the natural history of the islands is the preponderance of reptiles—the islands, indeed, have been called the Land of Reptiles, from the great numbers of snakes, lizards, and large tortoises which inhabit them, thus singularly contrasting with the Falkland Isles and the Fuegian Archipelago, which have scarcely a representative of this class. One species (*Testudo indica*) attains a weight of from 500 to 600 lbs., and easily carries a man on its back; they are sometimes ridden about by the sailors. One lizard is the only known marine species; it is 3 feet long, has webbed feet and compressed tail, basks on the beach, and subsists on seaweed—in its habits being somewhat analogous to the ichthyosauri and plesiosauri of a former era.

GALASHIELS', a thriving manufacturing town, parliamentary burgh, and burgh of barony of Scotland, in the counties of Roxburgh and Selkirk, 33½ miles from Edinburgh by railway, and 365 from London by the North British Railway, is situated on both banks of the Gala Water, about a mile above its junction with the Tweed. Though partly in Roxburgh, for all police purposes the burgh is held to be wholly in Selkirk It has sprung into importance in modern times, and except in the old town is well built, and contains many good houses. The staple trade is the manufacture of woollen goods known as "tweeds" and "plaidings," in which about twenty factories are engaged. There are several foundries and engineering and dye works. The established church, erected in 1813, is a semi-Gothic building. There is a plain but commodious corn exchange, and a spacious public hall; a handsome new church was erected in 1881. The other chief buildings are a volunteer hall, masonic buildings, and several places of worship. The population in 1881 was 12,434.

Galashiels was erected into a burgh of barony in 1599, at which date its population was only 400. But it is mentioned in history nearly three centuries before this date. It was once a royal hunting station, and was used as such when the king came to "the forest" to enjoy the pleasures of the chase. The tower, called "the Peel," a rudely-built square edifice of two storeys high, in which he resided, has been demolished. Gala House, the residence of the feudal superior of the burgh, is in its immediate vicinity. Abbotsford, the celebrated residence of Sir Walter Scott, is not above a mile distant, being on the opposite side of the Tweed, in the parish of Melrose. The ruins of the old tolbooth were pulled down in 1880. Gala is celebrated in Burns' song "The braw, braw Lads of Gala Water;" as are also the Tweed and its two tributaries in this neighbourhood, the Ettrick and Yarrow.

Galashiels was made a parliamentary burgh in 1868, and joins with Hawick and Selkirk in returning one member. It is governed by a provost, four bailies, and ten councillors.

GALATE'A, a Nereid or sea-nymph who loved the shepherd Acis. She was the daughter of Nereus. It was a statue of Galatea which the sculptor Pygmalion carved, and to which Aphrodite at his supplication granted life—a favourite story from the earliest times down to our own day. It has been treated in all kinds of ways, as opera, tragedy, melodrama, and comedy. One of the happiest and most recent versions is the graceful satirical comedy by Gilbert, which has afforded materials for brilliant success to more than one of our leading actresses.

GALA'TIA, a country of Asia Minor, which originally formed part of Phrygia and Cappadocia. It was bounded on the S. by Phrygia and Cappadocia, on the E. by Pontus, on the N. by Paphlagonia, and on the W. by Bithynia. These boundaries differed at various times. It obtained the name of Galatia from the settlement of a large body of Gauls in this part of Asia. The first horde that appeared in Asia (B.C. 279) formed part of the army with which Brennus invaded Greece. Encouraged by the success of their countrymen fresh hordes passed over into Asia; and their numbers became so great that Justin informs us (xxv. 2) "that all Asia swarmed with them, and that no Eastern monarch carried on war without a mercenary army of Gauls." The first check they received was from Attalus I., king of Pergamus, who defeated them in a great battle (B.C. 230), and compelled them to settle permanently in that part of Asia which was afterwards called Galatia (Livy, xxxiii. 21; Polybius, xviii. 24). They gave Antiochus great assistance in his contest with the Romans, and Cornelius Manlius the consul was sent against them, B.C. 189. The particulars of this war, which terminated in the complete defeat of the Galatians, are recorded in Livy (xxxviii. 12–27). From this time they were in reality subject to Rome, though allowed to retain their own native princes. In the war against Mithridates, Deiotarus, originally only a tetrarch of one of the Galatian tribes, assisted the Romans, for which he was rewarded by the grant of Pontus and Little Armenia, and the title of king by the Roman senate.

Strabo says that Galatia was inhabited by three tribes of Gauls: the Trocmi, the Tectosages, and the Tolistobogii. Each tribe was subdivided into four parts, and was governed by a tetrarch, who appointed a judge and an inspector of the army. The power of these twelve tetrarchs was limited by a senate of 300, who took cognizance of all capital cases. All other offences were left to the jurisdiction of the tetrarchs and judges. This form of government continued till shortly before the time of Deiotarus. All the tribes spoke the same language and had the same customs. Though they afterwards spoke Greek, they had not forgotten their native tongue in the time of Jerome, who says that they then spoke the same language as the Treviri.

Galatia possessed few towns of importance, with the exception of Ancyra, Tavium, and Pessinus. Pessinus, the capital of the Tolistobogii, north-east of the river Sangarius, was a great trading place, with a magnificent temple sacred to the mother of the gods, who was there worshipped under the name of Agdestis. On the river Sangarius in this province was the ancient Gordium, formerly the capital of the Phrygian monarchy.

Galatia was also called Gallo-Græcia, and its inhabitants Gallo-Græci, from the intermixture of the customs and languages of the Gauls and Greeks in this province.

GALATIANS, ST. PAUL'S EPISTLE TO THE, was probably written during the early part of the apostle's two and a half years' stay at Ephesus, which terminated in 57 or 58 A.D. The churches of Galatia had been founded by St. Paul during his second missionary journey (Acts xvi. 6), somewhere about 51 A.D., and had been revisited at the period of the journey through the country of Galatia and Phrygia recorded Acts xviii. 23, and which occurred probably in 55 A.D. Soon after this second visit the churches came under the influence of certain Judaizing teachers, who sought to impose the badge of circumcision and the claims of the ceremonial law upon the new converts. To attain their ends they disparaged and assailed the character and claims of the apostle, and represented that they came invested with superior authority derived from the apostles at Jerusalem, whom they represented as being in opposition to St. Paul. Many of the converts of the apostle went over to these new teachers, consenting to become circumcised and the proselytes of Judaism; thus it appeared as if the very essence and spirit of the gospel were in peril. Intelligence of this unhappy state of things reached St. Paul, and led to the writing of this epistle. At the commencement he expresses his surprise at the change that had taken place in their faith, deplores their instability, and then proceeds to vindicate both his own authority as an apostle and the purity of his gospel, invoking a curse upon anyone who should seek to change the latter. The second portion of the epistle is devoted to a discussion of the relationship between Judaism and

Christianity, the temporary character, the burden, and the imperfection of the former being contrasted with the glorious freedom and spirituality of the gospel. Finally, he exhorts to perseverance in the life of faith, a faith conditioned by and implying purity and holiness, and after a short recapitulation of the whole, closes with the apostolic benediction.

The genuineness and authenticity of this epistle have never been disputed, and it is, with the epistles to the Corinthians and Romans, accepted by the most negative school of modern criticism. Its importance in the study of the earliest growth of Christianity can hardly be over-estimated, and it has been well said by a modern writer that its composition "marks an epoch in history." The commentaries upon this book, both ancient and modern, are very numerous. A list of the commentaries of the fathers is given in the work on this epistle by Bishop Lightfoot (1865, second edition 1874). Luther wrote a commentary upon it, and said of it, "It is my epistle, I have betrothed myself to it, it is my wife." It also formed the subject of works by Calvin, Beza, and others among the reformers. Among modern writers the names of Lightfoot, Ellicott, Jowett, Alford, Sanday, and Venn may be mentioned.

GALATZ or **GALACZ** (pronounced *Galatsh'*), a town and port of Roumania on the Danube, 130 miles north-east of Bucharest by rail. It is the principal place of import and export for the kingdom, and the chief medium of the commerce carried on by Germany and Constantinople by means of the Danube. Its trade has considerably increased during the last half-century, and various Greek and English commercial houses have been established, as well as regular steam communication between Constantinople and Vienna.

Galatz is for the most part better built than the other towns of Moldavia, having numerous houses of stone, several Greek churches, in one of which is the tomb of Mazeppa, a convent, an hospital, and a large bazaar, always well filled with merchandise, together with a great number of warehouses for grain and other produce; the streets, however, especially of the old town, are narrow and dirty. Vessels of 850 tons burden can come close up to the town. The principal exports are corn, tallow, wool, honey, timber, hides, and skins; imports, cotton fabrics and twist from England, colonial products, olive-oil, and hardwares. The imports and exports together amount to an annual value of nearly £3,000,000. Steamers of any size have to lighten at Sulina, and the river is generally frozen over for a few weeks in the winter. The population is 80,000. The legendary origin of the name is from a colony of the same Galatians as those who invaded Asia Minor in 278 B.C.

GALAX'IAS is a genus of fishes, of the order PHYSOSTOMI, inhabiting the fresh waters of Australia, Tasmania, New Zealand, and Patagonia. These fishes have received from Europeans visiting or settling in those countries the name of trouts; they have somewhat the aspect of the river trout, being similarly spotted on the sides, but they have no scales, and want the adipose fin. The margin of the upper jaw is chiefly formed by the intermaxillaries, which are short and continued by a thick lip, behind which are the maxillaries. Strong hook-like teeth exist on the tongue, the jaws and palatine being also armed with strong teeth. The species, fourteen of which have been described, are all small fishes varying in length from 2 to 8 inches. Together with the genus Neochanna, which differs from Galaxias by the absence of ventral fins, this genus forms a family Galaxiidæ.

GAL'AXY (Gr. *gala*, *galaktos*, milk), the older name for the MILKY WAY. The word is now often used colloquially as almost synonymous with cluster or constellation; the after-dinner orator who alludes to the galaxy of beauty in the room probably thinks he compares the ladies to a cluster of stars, and is quite guiltless of any other allusion.

GAL'BA, SER'VIUS SULPI'CIUS, Emperor, was born, under the reign of Augustus, of a patrician family, served with distinction in Germany, was afterwards proconsul, first in Africa, and then in the Tarraconensis province of Spain, in which office he acquired a reputation for justice and moderation. He was in Spain when Julius Vindex, the proconsul of Celtic Gaul, rose against Nero, A.D. 68, and urged Galba to do the same. Upon Galba declaring against Nero he was selected as emperor by his soldiers, but he declared that he was only acting as the lieutenant of the senate and people of Rome, to put an end to the tyranny of Nero. The prætorian guards at Rome, after having revolted against Nero, proclaimed Galba, and the senate acknowledged him as emperor. Galba hastened from Spain to Rome, where he began by calling to account those favourites of Nero who had enriched themselves by proscriptions and confiscations. Continuing on this line he exercised great parsimony in the administration, and endeavoured to restore discipline among the soldiers. The emperor, who was past seventy years of age, soon became the object of popular dislike and ridicule; he was accused of being led by favourites who were hated, and revolts against him broke out in various quarters, several of which were put down and punished severely. A mutiny of his guards broke out, and Galba caused himself to be carried in a litter, hoping to suppress it, but the litter-bearers threw the old man down and ran away. Some of the legionaries came up and put him to death. He had reigned only seven months. He was succeeded by Otho, who had fomented the mutiny, January, 69.

GAL'BANUM is a gum-resin obtained from an umbelliferous plant, *Ferula galbaniflua*, a native of northern Persia. Three sorts of galbanum are distinguished—1, galbanum in grains or tears; 2, galbanum in masses; and 3, Persian galbanum. Galbanum is a spontaneous exudation from the plant, or is obtained by incision. The "tears" occur in irregular, generally oblong grains, mostly distinct, but sometimes agglutinated together, about the size of a lentil or small pea, of a colour verging from whitish into yellowish brown, more or less diaphanous, opaque, or shining with a resinous lustre. The odour is strongly balsamic and disagreeable. The taste is resinous, sharp, bitter, and disagreeable. Specific gravity, 1·212. It is partially soluble in alcohol, and the solution, as well as the strong white smoke which is evolved when galbanum is melted in a platinum spoon, reddens litmus paper. It consists chiefly of resin, gum, volatile oil, and a trace of malic acid.

Galbanum in masses consists of irregular pieces of a yellowish or dark brown colour; the odour is stronger than that of the preceding kind, which in its general characters it much resembles, except that it can be powdered only during the low temperature of winter. Persian galbanum, being very soft and tenacious, is sent in skins or chests. It often contains many fragments of plants.

Galbanum, like other umbelliferous gum-resins, is antispasmodic, expectorant, and externally rubefacient. It is inferior in power to asafœtida, but is usually associated with it in pills and plasters.

GALE (*Myrica Gale*), Sweet Willow, Sweet Gale, or Dutch Myrtle, a species of shrubby plant belonging to the order MYRICACEÆ, or Gale family. The leaves are simple, lanceolate, serrated, with resinous dots; the stem is shrubby, the catkins sessile and erect; the scales of the male catkins brown, with a white edge. The plant is strongly aromatic. It is met with in most northern countries of Europe, and is abundant in many parts of England and Scotland. It is also found in Siberia and South America. Sweet gale is a great favourite wherever it is found. It has a powerful odour, and is placed by country

people among their clothes, to keep away insects and to perfume them. In some parts of France its dried berries are put into broth as a spice. In the north of Scotland its leaves and tender twigs are used for beds. In the north of Europe it was in early times much used in brewing ale, to which it imparted highly intoxicating qualities. A dye of a yellow or orange colour is obtained by boiling the young plant gathered before the leaf-buds expand. A rose-pink is produced from the young shoots and delicate red roots; a solution of the nitro-muriate of tin is used as the mordant. By using larger quantities of the plant, and by further boiling, dyes of a brown and maroon are obtained. The plant in full leaf and flower affords a deep black, for which the best mordant consists of crystals of clear sulphate of iron or green vitriol.

GA'LEN, CLAU'DIUS, one of the most celebrated and valuable of the ancient medical writers, was born at Pergamus about 130 A.D. The exact time of his death is not known; but as he speaks of Pertinax and Severus as emperors, we may conclude that Suidas (v. *Galenos*) is not far from the truth in stating that he lived to the age of seventy. He was early instructed in the doctrines of the Aristotelian and Platonic philosophy, and appears also to have devoted some time to the study of the peculiar tenets of the other sects, for while yet very young he wrote commentaries on the Dialectics of the Stoic Chrysippus.

His anatomical and medical studies were commenced under Satyrus, a celebrated anatomist, Stratonicus, a disciple of the Hippocratic school, and Æschrion, a follower of the Empirics. After the death of his father he travelled to Alexandria, at that time the most famous school of medicine in the world. His studies were so zealously and successfully pursued that he was publicly invited to return to his native country. At the age of thirty-four he settled in Rome, where his celebrity became so great from the success of his practice, and more especially from his great knowledge of anatomy, that he quickly drew upon himself the jealousy of all the Roman physicians.

The school of medical philosophy which was founded by him may justly merit the title of eclectic, for its doctrines were a mixture of the philosophy of Plato, of the physics and logic of Aristotle, and of the practical knowledge of Hippocrates. On many occasions he expresses himself strongly on the superiority of theory to mere empiricism; but upon those matters which do not admit of being objects of experience, such as the nature of the soul, he confesses his ignorance and inability to give any plausible explanation.

To the mode of inquiry by repeated experiment Galen sometimes had recourse, and it is to be wished that he had more frequently made use of it. To prove the dependence of muscular motion upon nervous influence, he divided the nerves which supply the muscles of the shoulder, and found that after the division all power of motion ceased. He also deprived animals of their voice by dividing the intercostal muscles, by tying the recurrent nerve, or by injuring the spinal cord. In theoretical physiology his arrangement of the vital phenomena deserves to be particularly recorded, as it forms the groundwork of all the classifications which have since been proposed. It is founded upon the essential differences observed in the functions themselves. Observing that some of them cannot be interrupted without the destruction of life, and for the most part are unconsciously performed, while another class may be suspended without injury, are accompanied by sensation, and subject to the power of the will, he divided the functions into three great classes. The vital functions are those whose continuance is essential to life; the animal are those which are perceived, and for the most part are subject to the will; while the natural are performed without consciousness or control. He then assumed certain abstract principles upon which these functions were supposed to depend. He conceived the first to have their seat in the heart, the second in the brain, and the third in the liver. Thus the pulsations of the heart he considered due to the vital forces, these being communicated to the arteries by the intervention of the pneuma, the more subtle part of the air, taken in by respiration, and conveyed from the lungs to the left side of the heart, and from thence to the different parts of the body. In the brain, he asserted, the pneuma forms the medium by which impressions from external objects are conveyed to the common sensorium. The same principle he applied to the explanation of the natural functions also. Observing that these forces were not sufficient for the explanation of the different vital phenomena, Galen had recourse to the doctrine of elements, of which, after the example of Aristotle, and before him Plato in the "Timæus," he admits four, and from the mixture of these deduces the secondary qualities.

One of his theories is, that health consists in the perfect and harmonious admixture of these various elements, and that disease is that state of body in which the functions are in any way interrupted. It depends upon some disproportion in the constituent elements, or some unnatural condition of the organs. The causes of disease are divided by Galen into occasional and predisposing. The latter are supposed to depend upon some degeneration of the humours. This degeneration was called by him a putrefaction. It was upon this theory of the putrefaction of the humours that the practice of physicians was founded for centuries after the death of Galen, and their remedies were directed to the expulsion of the supposed offending matter.

The writings of Galen are valuable, not only for the history of medicine, but also for the great variety of miscellaneous matter which they contain.

GALE'NA, a city of the United States of North America, in the north-west corner of Illinois, on the Fevre River, 6 miles above its junction with the Mississippi, and on the railway 450 miles above St. Louis. It is famous as the centre of the great lead-mining district, but the quantity raised has considerably decreased of late years, owing to the increased depth of the mines, though in its place a large quantity of zinc ore is now obtained. It has manufactures of pottery, soap, and candles, and also lead furnaces, iron foundries, and numerous mills. It occupies a high and healthy site, and is for the most part substantially built of brick. The population in 1880 was 6451.

GALE'NA or **GALE'NITE** (from Gr. *galeo*, I shine, or from *galene*, tranquillity, as it was formerly supposed to possess soothing properties in cases of disease) is the most important ore of lead, as from it nearly all the lead of commerce is derived. It crystallizes in the isometric system, usually in cubes, has a very perfect cleavage, and bright metallic lustre with a bluish colour. Its hardness is 2·5, and its specific gravity about 7·5. This mineral is sulphide of lead (PbS), containing 86·6 per cent. of lead and 13·4 of sulphur. A portion of the lead is often replaced by silver, which, when present in paying quantities (about 3 ounces of silver per ton of lead), constitutes an *argentiferous galena*. Zinc, cadmium, and antimony are also sometimes present.

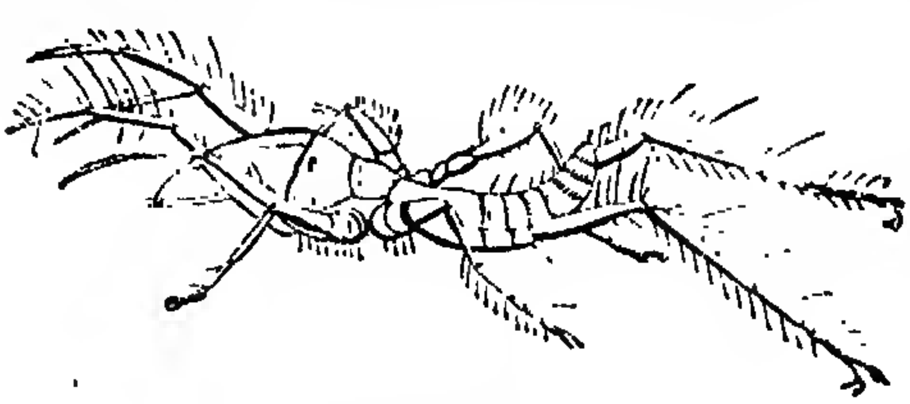
Galena occurs in both veins and irregular deposits; it is commonly associated with some alteration product, as either sulphate, carbonate, or phosphate of lead, and such sulphides as zincblende, iron, and copper pyrites or calamine; the gangue is usually calcite, fluorite, dolomite, and barytes or quartz; and in granite or gneiss zeolites sometimes occur. In Spain it has been found in granite, and at Freiberg, Saxony, in gneiss. It is found in argillaceous slate in the Hartz and in Cornwall, where the lodes have an approximately north and south direction; the galena, with a finely granular texture, being considered as the most promising for a high percentage of silver. The rock in which this ore is most abundantly found is limestone,

where it occurs both in large irregular masses and in veins. In Derbyshire and the north of England it occurs in Carboniferous limestone; Permian fossils have, however, been found in the veins, showing them to be of subsequent production. In Austria and at Sala in Sweden, besides numerous other localities, it is found also in limestone. In America it occurs in very large quantities, notably in Missouri, Illinois, Iowa, and Wisconsin. At the Bow Pass, North-west Territories, it occurs in grits and sandstones.

In order to obtain metallic lead from this mineral, the concentrated ore is roasted in a reverberatory furnace so as to oxidize the sulphur, a little lime being added as a flux for the gangue or any silicious portions. Plumbic oxide and sulphate are formed, and when the operation is complete the heat is raised so as to fuse the mass; sulphur dioxide is then driven off, and metallic lead liberated. In order to facilitate the reduction of the lead, metallic iron is sometimes added at this stage. This lead generally contains much impurity, and is purified by oxidizing the foreign base metals on the hearth of a reverberatory furnace and skimming off the scoriæ, after which it is cast into moulds, forming pig-lead; when argentiferous, this has to be subjected to the additional process of *desilverization*. The lead produced on the Scotch hearth is as a rule purer than that of the reverberatory furnace, on account of the lower temperature at which it is reduced. In the Scotch hearth the calcined ore—"browse" or "bronze"—with lime is placed on lighted peat, and the temperature raised by means of a blast of air from a tuyere; ultimately the metal is separated and collects in a hollow at the base of the hearth, from which it is drawn when sufficient has been collected.

Artificially-formed crystals of galena are not uncommon in the throats of blast furnaces; they are apparently the result of sublimation.

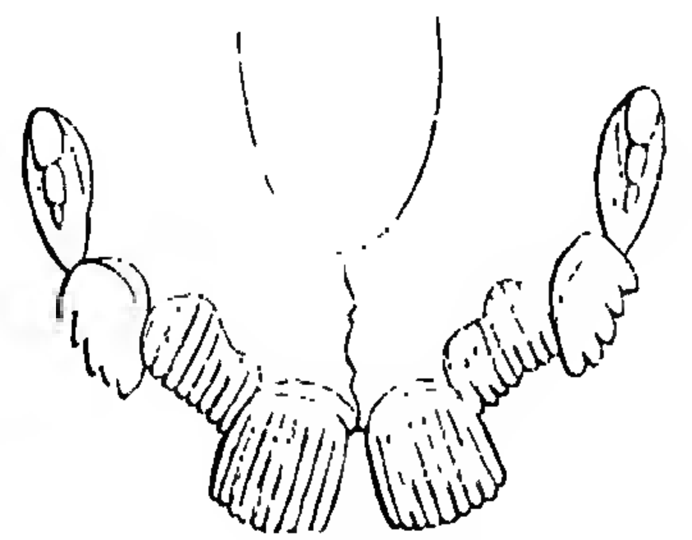
GALEO'DES is a genus of ARACHNIDA, belonging to the order SOLPUGIDEA, which includes several spider-like animals, some of which are of a dangerous character. The common species, the *Galeodes arenoides*, lives principally in the sandy deserts of the Old World, and attains the length of about 2 inches. The cephalothorax is broken up



Galeodes arenoides.

into four distinct segments. The body is hairy. The first pair of appendages, the chelicerae, are very long, powerful, nipple-like organs, and their power of offence is increased by the poison glands with which they are furnished. The next two pairs of appendages are in the form of tactile palps of great length but without claws. The next three pairs form the walking legs. The head bears two eyes. Respiration is by tracheæ. The abdomen is separated from the cephalothorax. These animals run with great swiftness, and are very voracious, sometimes attacking lizards and even birds. When threatened they retreat with their nippers raised in an attitude of defiance. It is said that they are a great pest to camels when traversing the desert, and that they are extremely venomous.

GALEOPITH'ECUS is a genus of very aberrant mammals, presenting characters so singular that its position among the mammalia has been for long a disputed point. When the first species was discovered in the seventeenth century it was classed among the lemurs. Later on its so-called powers of flight procured it admission among the bats. Linnæus placed this animal in his genus Lemur. Most zoologists now agree in regarding it as belonging to the INSECTIVORA, but being exceedingly aberrant and of low type. The limbs are long and slender. They are connected by a broad hairy expansion of the integument arising from the sides of the neck and extending along the body down to the base of the claws of the feet, forming a web between the fingers the toes. This membrane (*patagium*) is continued between the hinder limbs to the very extremity of the tail. When in use it is widely extended by means of the limbs, and then serves its possessor in the way of a parachute, enabling him to spring from tree to tree at great distances.



Lower incisor teeth of Galeopithecus volans.

Hence the name of flying lemurs by which the Galeopitheci are commonly known. But it must not be supposed that this action constitutes true flight; it is merely a parachute like sailing through the air; the impetus being given by the spring of the creature from an elevated position, the expanded membrane buoys it up for a considerable distance, although it has no power to sustain or elevate itself in the air by its own exertions. A similar structure, adapted to the same end, occurs in the flying squirrels and flying phalangers, and it is widely different from the true wings by which the bats are enabled to take their swift and noiseless flights through the dusky evening air. The limbs of Galeopithecus have particularly long and slender bones. The ulna is united to the radius towards the extremity; the tibia and fibula are distinct. All the feet have five digits of nearly equal length, united to each other by a web and armed with sharp strong claws. The skull is remarkably solid, and the brain-case very small, indicating a low degree of intelligence.

In the structure and arrangement of the teeth Galeopithecus is quite peculiar. The incisor teeth are four in number in each jaw, but those of the upper jaw are placed quite at the sides, in a line with the molars, so as to leave a wide vacant space in front above the lower incisors. The hindmost of the upper incisors are also remarkable for having two roots, a character unique among mammals. The lower incisors are broad and flat, and have their crowns curiously cleft in such a way as to resemble small combs (see cut). There is a single canine in each jaw, with two roots and a notched crown. The premolars are two and molars three on each side of each jaw. There are two pairs of mammæ, placed on the side of the breast near the armpits. The intestine is furnished with a large sacculated cæcum. The best known species of this genus is the Colugo, the Flying Lemur of Linnæus (*Galeopithecus volans*). It is a native of several of the large islands of the Eastern seas, especially Java, Sumatra, and Borneo, and also of Penang, Siam, and the peninsula of Malacca on the continent of Asia. It is of a blackish-gray colour above, with some whitish spots, and of a tawny gray beneath; its feet are blackish, and its total length is about 18 inches.

In the luxuriant forests of the countries above-mentioned

the calugos exist in considerable numbers, but they are said to select particular spots for their dwelling-places, especially gentle hills covered with young trees, in the thick branches of which they find a secure retreat and quietly sleep away their days. The night is the season of their activity, and then they may be seen springing obliquely from one tree to another, often at a distance of a hundred yards or more, at the same time uttering a hoarse, croaking, disagreeable noise. On the ground, however, they are very helpless, advancing by a succession of little awkward leaps until they reach some object which they can ascend, when they climb up by the aid of their claws, somewhat in the manner of a cat. They feed upon fruits and young leaves, preferring those of the cocoa, palm, and a species of bombax, to the plantations of which, surrounding the native villages, they often do much injury. According to some authors they do not adhere strictly to a vegetable diet, but feed also upon insects, and even upon small birds when they can seize them. The Colugo is so tenacious of life that it is almost impossible to kill it. A second species (*Galeopithecus philippinensis*), from the Philippine Islands, has been described differing slightly in size and in the form of the upper incisors.

GALE'RIUS, Emperor of Rome, was once a simple herdsman, and was hence sometimes called *Armentarius.* His full name was Galerius Valerius Maximianus. By merit he rose to the supreme command, and was named Cæsar and vice-emperor by Diocletian at the same time as Constantius Chlorus, Maximian being already Diocletian's partner in the empire. He married Diocletian's daughter, and ruled Illyria, Thrace, and the line of the Danube. He crushed the Persian power in a brilliant series of campaigns. When Diocletian retired from the throne in 305, Galerius became emperor. Although it was Galerius who advised the persecution of the Christians which bears Diocletian's name, it must be remembered that the Christians were innovators, and as such extremely obnoxious to high-minded emperors such as Diocletian and Galerius, who desired to restore the old Roman national spirit. It is quite noticeable that the better the emperor the more did he persecute the Christians. Galerius soon found that mere cruelty resulted, conversion being rarely or never effected, and since the Christians were unresisting he stayed the persecution in 309 in a very noble edict, granting full liberty of conscience. He died in 311. A very few years after his death saw his colleague Constantine (son of Constantius) a Christian, and Christianity the religion chiefly patronized by the state.

GALI'CIA, an old province and consulship of Spain, but since 1833 forming the provinces of Corunna, Lugo, Orense, and Pontevedra, occupies the north-west extremity of the peninsula, between 41° 50′ and 43° 50′ N. lat., and 6° 50′ and 9° 15′ W. lon. The country is mountainous, being covered by several offsets of the Asturian chain, one of which runs westward towards Cape Finisterre; another runs to the south-west along the right bank of the Minho, dividing the waters of that river from those of the Ulla and the Tambre, and reaches the coast of the Atlantic south of Vigo; while a third ridge crosses the south of the province, dividing the feeders of the Minho from those of the Douro, and extending into Portugal. The principal rivers are—1, the Minho, which rises in the mountains of Mondonedo, in the north of the province, flows southwards by Lugo and Orense, and receives the Sil, which comes from Leon and the mountains of Astorga: on touching the frontiers of Portugal it runs west along the boundary of Galicia and Portugal to its entrance into the Atlantic below Tuy; 2, the Tambre, which rises in the mountains north of Santiago de Compostela, and flows south-east into the Atlantic; 3, the Ulla, which rises in the centre of the province, and flowing westwards enters the Atlantic south of the Tambre; 4, the Lima, which rises in the mountains south-east of Orense, and flowing south-west into Portugal enters the Atlantic through the harbour of Viana. The principal products of Galicia are wine, fruits, flax, wheat, barley, maize; good pastures feed a vast quantity of cattle, and there are abundance of chestnuts, which constitute a common food of the peasantry. The forests supply plenty of fuel and timber. The climate is generally chill and moist, but more temperate on the sea-coast than in the interior. The Gallegos or Galicians are allied in race to the Portuguese, and are a hardy, industrious, and docile people. Many of them visit Portugal, where they are employed as porters and water-carriers; and they have an established reputation for honesty. The principal manufacture of the country is linen.

The Callaici, the ancient inhabitants of this district, were first conquered by Decimus Junius Brutus, and wholly subjugated by Augustus, who included the country in the province of Tarraconensis. The Visigoths took the country from the Romans, and were in their turn driven from it by the Moors. The princes of Asturias retook it from the Moors and annexed it to their kingdom, which was united with Castile in 1039.

GALI'CIA (or **GALIZIA**) and **LODOMIRA,** with **CRACOW,** a crown-land or province of the Austrian Empire. It is bounded on the W. by Silesia, S. by Hungary and Transylvania, E. by Russia, and N. by Poland, Prussia, and Russia. The area is 30,000 square miles, and the population 6,000,000. The inhabitants are of Slavonic origin, and speak the Polish language; there are many Jews, mostly merchants and distillers; the remainder is divided among the Roman Catholic and Greek churches, and there are a few Protestants.

Galicia spreads out, on the northern side of the Carpathian Mountains, into extensive plains; these mountains extend their arms deep into the kingdom, and rise in many instances to a height of from 4000 to 7000 feet. The Bukovina is covered with offsets of the Carpathians, and is altogether a mountain region. The mountains are full of small lakes, and the plains and lowlands consist chiefly of loam and sand.

The rivers of the western parts of Galicia belong to the basin of the Vistula, and those of the eastern to the basins of the Danube and the Dniester. The tributaries of the Vistula within the kingdom are chiefly the Danayez, the Poprad, the Wysloka, the Saan, and the Bug. The other principal rivers, besides the above and the Danube and Dniester, are the Pruth, the Sered, and the Moldava.

The climate of Galicia is colder than that of any other possession of Austria, in consequence of the proximity of the Carpathians. The summer is generally short, and the grape never ripens; the winter is very severe for six months at least. The country abounds in sandstone, granite, quartz, slate, potter's earth, yellow ochre, marble, gypsum, &c. Mountain crystals, agates, jaspers, ordinary opal, alabaster, &c., are found in several spots. The Carpathians yield iron, gold, silver, lead, copper, sulphur, and salt.

The benevolent institutions in the province are numerous, but the educational establishments are in a backward state. The chief town is Lemberg.

The principal kinds of grain produced are wheat, rye, oats, and barley. Buckwheat, pease and beans, potatoes and other common vegetables, succory, clover, flax and hemp, tobacco, aniseed, rape and other seeds for making oil, a few hops, &c., are also grown. Tar and potash are made in considerable quantities.

Large droves of horned cattle are fed, the finest being brought from Moldavia. Something has been done towards improving the race of sheep, and Galicia now produces some fine wool. In the eastern districts much honey and wax are made; the red wax of the Bukovina is in great repute. The rivers, small lakes, and ponds are well supplied with fish. The bear, wolf, fox, beaver, roebuck, stag,

lynx, marmot, eagle, vulture, swan, heron, wild goose, squirrel, and hare are the principal wild animals. The mining is chiefly confined to iron and salt; the other mineral products are raised in very small quantities. The manufactures are gradually extending, though they are still on a confined scale. The country people in general make the materials for their clothing. The spinning and weaving of flax and hemp give employment to thousands. They manufacture very coarse and durable linen, and, in some parts, a few fine cloths, damask and table linen, &c. There are a few woollen and cotton manufactures; and there are also manufactures of paper, wooden utensils, brandy, tobacco, beet-root sugar, leather, &c. The exports consist of horses, cattle, skins and hides, wool, grain, salt, timber, potash, aniseed, &c.; and the imports of raw materials, wines, and colonial produce.

Previous to 1374 Galicia formed a part of Hungary. It was then incorporated with Poland; but in 1773 it was surrendered to Austria, and annexed to the Austrian dominions under the name of the kingdom of Galicia and Lodomira. In 1846 Cracow, with the territory belonging to it, was, by a treaty of the three powers, Austria, Russia, and Prussia, given up to the Emperor of Austria, and by him annexed to the crown-land of Galicia.

GAL'IEÆ, a tribe of plants belonging to the order RUBIACEÆ. It consists of herbaceous, usually square-stemmed plants, with the stipules of the same form as the leaves, so that the leaves appear to be in whorls. Some yield a dyeing substance in their roots, as the various species of madder, but the greater part are useless weeds. One of our common British species of Galium, viz. *Galium verum*, is astringent, and was formerly used by farmers to curdle milk.

GALILE'ANS, an ancient Jewish sect, which received its name from Judas the Galilean. They were distinguished for their opposition to the Roman tax established by Quirinus; and they carried on a kind of civil war, which continued with more or less opposition till the destruction of Jerusalem by the Romans.

GAL'ILEE. See PALESTINE.

GAL'ILEE, a sort of antechapel or western porch before some of our cathedrals, the object of which was to allow certain classes (probably women) to hear the service without entering the church. The Early English galilee at Ely (finished in 1215) is extremely beautiful, and the Late Norman galilee at Durham is a fine characteristic example of its period (begun in 1153); Lincoln has also a galilee, but it is not comparable in effect to the others.

GALILE'I, VINCENZO, father of the illustrious Galileo Galilei, was born in the early half of the sixteenth century, and studied music under Zarlino. His chief work was "Dialogo della Musica Antica e Moderna," a folio volume printed at Florence in 1581. He was an exquisite performer on the lute, and was one of that famous Florentine Academy to whom we owe the invention of opera, in somewhat the same manner as we owe chemistry to the alchemists. Galilei and others formed themselves into the academy for the purpose of reviving the musical declamation of the ancient Greeks, and Galilei in his Dialogo published three specimens of ancient Greek music, which he copied from a Greek MS. in the library of Cardinal St. Angelo at Rome, part of the treasures then pouring into Italy in consequence of the conquest of the Eastern Empire by the Turks. These three specimens are all we yet possess. Working them out as well as he could Galilei wrote, in what he thought was a similar style, a monody on an episode from Dante's "Inferno." This was received with great favour, being as far removed as possible from the learned and overloaded style of professed musicians of the time. It apparently was a kind of richly dramatic recitative. Soon Peri and Caccini, continuing the example given by Galilei, were able to dignify the marriage-festival of Henri Quatre of France to Maria de' Medici in 1600, at Florence, with the first opera, on the subject of the death of Eurydice. The Florentine amateurs failed to revive the Greek recitative, but they did more, they led the way to all the beauty of opera and oratorio.

GALILE'O, the eminent astronomer, whose full name was Galileo Galilei, was the son of Vincenzo Galilei. He was born at Pisa, in Tuscany, on 15th February, 1564. Having acquired during his boyhood, and under adverse circumstances, the rudiments of classical and polite literature, he was placed by his father at the University of Pisa in his nineteenth year. Galileo was designed for the medical profession, but determined to renounce it in favour of geometry and experimental philosophy, to which his father reluctantly agreed. His first important discovery was the isochronism of the vibrations of a simple pendulum sustained by a fixed point. This equality or near equality of the time of vibrations Galileo recognized by counting the corresponding number of his own pulsations. The observation was first made upon the great suspended chandelier in the Cathedral of Pisa, which the lighter had left swinging after preparing it for service. The chandelier still hangs there, an object of interest to those who care for the romantic element in science. The fall of the apple from Newton's tree is a parallel instance of a common occurrence seen by all thousands of times over and carelessly passed by, but leading observant genius to stupendous results. It was fifty years after he saw the lamp swing that Galileo made his first astronomical clock.

Through the good offices of his old teacher Guido Ubaldi, who admired his talents and foresaw their future development, Galileo was introduced to the Grand-duke Ferdinand I. de' Medici, who appointed him mathematical lecturer at Pisa (1589), though at an inconsiderable salary. Here he commenced a series of experiments on motion, a subject on which his first inferences were not correct; but he had learned enough from his experimental course to perceive that most of the scholastic assumed laws of motion were untenable.

The mind of Galileo becoming thus unfettered from the chain of authority, he resolved to examine the rival systems of astronomy. He soon discovered and proved the futile nature of the objections then usually made against the Copernican system, which were founded on existing ignorance of the laws of mechanics, or on some misapplied quotations from Aristotle, the Bible, and the Fathers; and having also observed that the Ptolemaic required almost daily some new emendation, that the appearance and disappearance of new stars contradicted the pretended incorruptibility of the heavenly bodies, together with other reflections which he has collected in his dialogues, he became a convert to the Copernican system. One of the false doctrines which he first combated was that bodies of unequal weights would fall through the same altitude in unequal times; thus, if one body were ten times as heavy as another, it should fall through 100 yards while the lighter body had only fallen through 10. But though the experiment was performed from the leaning tower at Pisa, and both bodies reached the ground at almost the same instant (the small difference, as Galileo rightly observed, being attributable to the unequal resistance of the air), the witnesses of this experiment were not convinced, so inveterately were they prejudiced in favour of the doctrines in which they had been taught to place implicit belief. At this time he also put forth the true theory of projectiles.

Instead of making converts by his experiments, Galileo discovered that he had made many secret and some open enemies; he therefore left Pisa, and removed to the University of Padua (1592), where he was appointed to a professor's chair for the limited period of six years. Here he invented the thermometer; though, as it was composed

of a tube in an open vessel, it was necessarily an imperfect instrument. The use of a sealed vacuum-tube by Rivieri (1646), and the substitution of mercury for water in 1670, were the only two changes since made. He also invented the proportional compasses still used by architectural draughtsmen, &c. His correspondence with Kepler commenced about the same period. A treatise on the sphere, after the Ptolemaic system, which is attributed to Galileo, appeared about the same time. On his reappointment to the professorship at Padua, his salary was doubled, his fame increased, and his lectures were crowded; but these flattering events were overbalanced by a disagreeable intermittent disease to which he then first became subject, and which pursued him for the remainder of his life. A new star, almost as brilliant as that which directed Tycho Brahe's mind to the study of astronomy, having appeared in 1604 in the constellation of Ophiuchus, he made it the subject of his lectures. He read and admired Gilbert's work "On the Nature of Bodies," adopted his views on the subject of terrestrial gravity, and constructed magnets after his example; about the same time he attacked with some bitterness one Capra, who ascribed to himself the invention of a species of compass which Galileo had made; and he wrote also on practical methods for the measurement of heights and distances. Shortly afterward he states in a letter, that "he intended hereafter to write three books on the system of the universe; three books on local motion; three books on mechanics; also on sound, speech, light, the tides, continuous quantity, animal motion, and castrametation." Many of these works, it is supposed, were destroyed by his relatives after his death, at the instance of the family confessor.

The year 1609 was signalized by the construction of the Galilean telescope, which consisted of a plano-convex object-glass and a plano-concave eye-glass, and thus be laid the foundation of his brilliant discoveries in the solar system. The invention of this noble instrument of science must be granted to Lippershey, a Dutch optician; but upon merely hearing of the rumour the great Florentine seized the idea, and without any communication with Lippershey invented the instrument afresh for himself. Although not strictly the inventor of the telescope, its application by Galileo to astronomy for the first time is indisputable. His first telescope was presented to the Doge of Venice, by whom the professorship of Padua was confirmed to him for life, with the greatest salary which had ever been there given to the mathematical professor, namely, about 1000 florins. Galileo, impatient to obtain ocular evidence of what he called the structure of the universe, soon provided himself with a second instrument, and on directing it towards the moon, this luminary became immediately stripped of the character of geometrical perfection attributed to all the celestial bodies by the schoolmen. The more obscure parts of the lunar surface, which they imagined had arisen from some earthly taint consequent on the proximity of the moon, being now rendered distinctly visible, taught Galileo that the surface of the moon was irregular and uneven. In pursuing these observations, he found that the moon constantly turns towards the earth the same face, so that nearly a hemisphere of her surface can never be visible to us. From this remarkable fact he does not appear to have drawn the inevitable consequence, that the time of her rotation round her own axis, and the time of a revolution round the earth, must be exactly equal. Galileo subsequently observed the librations of the moon, by which small portions of her more distant hemisphere are alternately brought in view. The idea which was suggested from the appearance of oceans and continents, mountains and valleys, on the moon, that she might be habitable, overwhelmed the schoolmen with horror, and struck the religious with alarm.

On examining the nebulæ, and particularly the Milky Way, with his glass, he perceived that they were composed of myriads of stars, or, in the language of Milton, "powdered with stars." It may be remarked in passing that Milton visited Galileo, and entertained the highest opinion of his philosophy, to which he makes some beautiful allusions in his "Paradise Lost."

The planet Jupiter furnished matter for still greater wonder. Galileo perceived three very small stars eastward of the planet, and close to its disc; two of them, on a subsequent observation, had distinctly changed position to the westward. He soon perceived that they were satellites; and shortly afterwards he discovered the fourth. The strength which this discovery gave to the Copernican system, from the analogy with our moon, was very great; nor did his ever-active mind fail to perceive that it might be employed in determining longitudes at sea. On examining Saturn with the telescope, he perceived his ring, but viewing it in perspective, he took the lateral portions for two stars.

His next discovery was the crescent form of Venus when in or near conjunction. His discovery of spots on the sun's disc, which were evidently attached to that luminary, was a severe blow to the imaginary perfection of the schoolmen. The Jesuits had always entertained a cordial hatred for Galileo, as he had joined the party by whom they had been expelled from Padua; and though Galileo energetically repudiated any antagonism to religion the Inquisition was implacable, and ordered a friar named Caccini to draw up depositions against him. After his appearance in person at Rome in 1615 the proceedings dropped, but in what manner is not clearly stated.

In March, 1616, the pope (Paul V.) granted Galileo an audience, and assured him of his personal safety, but he was enjoined not to teach the Copernican doctrine of the motion of the earth. He had soon occasion to turn his attention again to astronomy, for in 1618 there appeared no less than three comets, on which occurrence Galileo advised his friends not to conceive too hastily that comets are planets moving through the immensity of space, but that they may be atmospheric; his reasons for this, though ingenious, are fallacious, as are those which he afterwards gave for the causes which produce tides, which he attributes to the unequal velocities of different parts of the sea by reason of the combination of the rotatory and progressive motions of the earth, which at some points conspire together and at others are opposed. He afterwards went to Rome, and was received with great kindness by the next pope (Urban VIII.); his enemies were silenced for a while, and he was sent home to Tuscany loaded with favours and presents; and though his patron, Cosmo II. de' Medici, was dead, Ferdinand II., Cosmo's successor, showed him strong marks of esteem and attachment.

In 1630 he finished, and in 1632 published his celebrated work, "Dialogue on the Two Great (Ptolemaic and Copernican) Systems," which he dedicated to Ferdinand II. of Tuscany. By giving the work this form he evaded his promise not to teach the Copernican doctrines. Three fictitious persons conduct the dialogue: Salviati, a Copernican; Sagredo, a banterer on the same side; and Simplicio, a Ptolemaist, who gets much the worst of the contest both by jokes and argument. The Inquisition resolved not to allow the attempted evasion of a solemn promise. Galileo was accordingly summoned to Rome, though he was seventy years of age and overwhelmed with infirmities; he had, however, all the protection and comforts which the grand-duke could confer on him, being kept at the Tuscan ambassador's house; and this spirited man (Nicolini) even wished to maintain him at his own expense when he perceived a precarious disposition in Ferdinand's minister.

After some months' residence in Rome he was again summoned before the Inquisition, and on the 20th of June

appeared before the assembled inquisitors in the convent of Santa Maria Sopra Minerva. Here he made his celebrated recantation of the Copernican doctrine. Rising from his knees after this solemnity he is said (though on very poor authority) to have whispered to a friend, *E pur si muove* ("It moves for all that").

Afflictions followed quickly in the old age of Galileo. In April, 1634, he lost a beloved daughter who was his chief stay. He was allowed to return to Arcetri, where she breathed her last, but he was still kept in strict confinement. After two years spent in this unhappy condition, his confinement became more rigorous, through some new suspicions entertained by the pope, so that, after having been allowed to remove to Florence for the benefit of his declining health, he was ordered to return to Arcetri. In 1636 he became totally blind, about which time he finished his "Dialogues on the New Sciences," a resumé of his experiments and theories in mechanics, &c., which is his most valuable written work. Though he believed this work could not annoy the holy office, yet the terror was so great and universal that he could not get it published until some years afterwards, when it was undertaken at Amsterdam. While Torricelli, one of his favourite pupils, was arranging a continuation for the "Dialogues on Motion," Galileo was suddenly taken ill with a palpitation of the heart, and, having lingered two months, he died on the 8th of January, 1642.

Galileo appears to have been of a sprightly temperament, easily crossed and easily reconciled; his kindness to his relatives, which distinguished him from his childhood to old age, and which went frequently to such an extent as to embarrass himself, forms a noble trait in his domestic character. He was universally beloved. He contrived to have his natural son Vincentio legitimized, but afterwards had the misfortune to find his hopes in this lad disappointed. One of the best editions of his collected works is that published at Milan in 1811, in thirteen vols. 8vo. They have also been published in separate tracts.

Among the most celebrated pupils of Galileo are Viviani and Torricelli, the former of whom in particular bore a strong attachment for his master; the latter invented the barometer. Viviani also wrote his life, and left a legacy to raise a monument to his memory. It may be noted that Michael Angelo died the year Galileo was born, and that Newton was born in the year of Galileo's death.

GALIPE'A, a genus of shrubby or arborescent plants inhabiting the warmer parts of South America: it belongs to the order RUTACEÆ. The flowers are small, white or pink, often fragrant, with a gamopetalous corolla. The most remarkable species is the *Galipea Cusparia*, a plant yielding Angostura bark. It is found in the neighbourhood of Angostura in Venezuela, and also in New Granada. It is a tree of from 12 to 15 feet in height, having a gray bark and trifoliate leaves, with oblong leaflets about 10 inches in length. Angostura bark is obtained both from the stem and branches. In the treatment of the bilious diarrhœa frequent in damp autumns in this country, after proper evacuants, it is of the most decided utility. In common English cholera, likewise, and slighter cases of Asiatic cholera, it is the most beneficial agent which can be resorted to. It is best given in the form of infusion, and may either be administered alone or with the addition of dilute nitric acid and tincture of opium, which last may be discontinued after a few doses. See ANGOSTURA BARK.

GA'LIUM, a genus of plants belonging to the tribe Galieæ and order RUBIACEÆ.

Galium Cruciata (crosswort) is a native of Europe and Siberia, and is commonly found in Great Britain.

Galium Mollugo (great hedge-bedstraw or wild madder) is native throughout nearly all Europe and the Caucasus, and is found in Britain. The flowers are white and sometimes yellowish. The roots are creeping, and yield a red dye like the true madder, but of a brighter colour; they also have the property of colouring the bones of animals red that feed upon them. This plant has been extolled as an effectual cure for epilepsy.

Galium tinctorium (dyers' bedstraw) is a native of North America, in low marshy places, especially in Canada and Newfoundland.

Galium palustre, a native of Europe and Great Britain, nearly resembles *Galium tinctorium* when the leaves are more numerous than usual. It is said that from the roots of this plant the Indians extract the red dye with which they colour their feathers and the ornaments of their dress.

Galium septentrionale (the northern bedstraw). The Cree women use the roots of this plant to dye red. It is a native of North America, about the lakes of Canada and the United States.

Galium verum (ladies' bedstraw or cheese-rennet). On loose sandy soils the flowers are sometimes solitary and the stems much more branched, but agreeing in other respects with this species. It is a native of Europe and Siberia, in meadows, woods, and among bushes, and is found in Britain very commonly in dry soils. The stalks and flowers of this plant have been used in the cheese counties for the purpose of curdling milk, and also for colouring it. Mathiolus says it produces an agreeable flavour, and makes the cheese eat sweeter. The French formerly used to prescribe the flowers in hysteria and epilepsy. The roots afford a rich red dye, superior in colour to madder. It was grown at one time as a substitute for the true madder (*Rubia tinctorium*), but the roots are too small to render its culture profitable.

Galium Aparine (the common goose-grass or cleavers) is a native throughout the whole of Europe, Northern Asia, and North America, in hedges, fields, and most cultivated places; it is plentiful in Great Britain. The expressed juice of this herb, taken in doses of 4 oz. or a quarter of a pint night and morning, during several weeks, is said to be a very beneficial remedy in cutaneous disorders, and is believed by the country people to be a purifier of the blood and an antiscorbutic. The seeds have a corneous albumen, and when roasted have been used instead of coffee; but they do not contain any principle analogous to caffeine, and so cannot be considered as a real substitute. The roots of this species, like most of the genus, afford a rich red dye, and, like madder, they possess the property of imparting a red colour to the bones of birds and animals which feed upon them.

The roots of *Galium tuberosum* are farinaceous, and in China are cultivated as a dietetic vegetable.

There are about 200 species of Galium, which are distributed in every quarter of the world. The common name Bedstraw, given to all the species, is from the verb to *strew*, anciently written *straw*. Before the introduction of modern luxuries beds were strewed with various herbs, and doubtless this was one used for that purpose.

GALL, DR. FRANCIS JOSEPH, the founder of the system of phrenology, was born at Tiefenbrunn, in Swabia, on the 9th of March, 1758. He began the study of medicine at Strasburg, but removed to Vienna in 1781. Here, being on terms of intimacy with Dr. Nord, physician to a lunatic asylum in Vienna, he carefully examined all the insane there, observing the peculiar character of the insanity in each and the corresponding forms of their heads; he frequented prisons and courts of justice, and made notes of the crimes and appearance of all the prisoners. In short, wherever there was any person made remarkable by good or bad qualities, by ignorance or by talent, Dr. Gall lost no opportunity of making him a subject of his study. With the same views he was constant in his study of the heads and characters of both wild and domesticated animals. Having obtained his diploma, he made it his care, as far as possible, to ask for leave to examine the brains of all whose

characters and heads he had studied during life, and soon found that, as a general rule, the exterior of the skull, though not moulded on the brain, yet in its variations of contour corresponds with the variations of the form of the brain contained within it.

At length, after unremitting exertion and constant study for upwards of twenty years, Dr. Gall delivered his first course of lectures in 1796, at his house in Vienna. Supported by a vast accumulation of facts, he endeavoured to prove that the brain was the organ on which all external manifestations of the mind depended; that different portions of the brain were devoted to particular intellectual faculties or moral affections; that, *cæteris paribus*, these were developed in a degree proportioned to the size of the part on which they depended; and that, the external surface of the skull corresponding in form with the surface of the brain, the character of each individual was clearly discernible by an examination of his head.

A doctrine so new, and so subversive of all that had been previously taught in psychology, produced no little excitement. Gall gained disciples daily, and in 1800 Dr. Spurzheim became his pupil. In 1804 this gentleman was associated with him in the study of his science, and to this event phrenology, as it now came to be called, probably owes much of its clearness and popularity. Soon after their association, Drs. Gall and Spurzheim commenced a tour through the principal towns in Germany and Switzerland, diffusing their doctrines, and collecting everywhere with the most assiduous industry fresh evidence in their favour. In 1807 they arrived at Paris, which became at once the field of their principal labours and of the most vehement discussion.

Dr. Gall continued in Paris till his death, which occurred on the 22nd of August, 1828. He had suffered for nearly two years previously from enlargement of the heart, which prevented him, except at intervals, from pursuing his lectures, and at length produced a slight attack of paralysis, from which he never recovered. At the *post-mortem* examination his skull was found to be of at least twice the usual thickness, and there was a small tumour in the cerebellum.

GALL, CANTON OF ST., one of the cantons of the Swiss Confederation, situated at the north east extremity of Switzerland, is bounded on the N. by Thurgau and the Lake of Constance, E. by the Vorarlberg, S. by the Grisons and Glarus, and W. by Schwytz and Zürich. Its area is about 770 square miles, and its population in 1880 was 210,401. St. Gall was formed at the beginning of the present century, by the union of the territories of the Abbot of St. Gall with the free town of St. Gall, and several districts formerly subject to the old cantons, namely, the Rheinthal, Sargans, Werdenberg, Utznach, Gaster, and Sax, and the town of Rapperschwyl. The spoken language of St. Gall is a dialect of the German, resembling the Swabian.

The canton of St. Gall is in great part a mountainous country, being intersected by various offsets of the Alps. The general slope of the surface is towards the north and north-west, the streams running in those directions. The principal rivers are the Rhine, the Seez, the Thur, the Sitter, the Goldach, the Tumine, and the Neckar. The agricultural produce consists chiefly of wine, fruits in great abundance, corn, potatoes, and pastures. There are considerable forests, and much wood is exported. The domestic animals are oxen, sheep, goats, pigs, and horses. The rivers and lakes abound with fish and water-fowl. There are iron, coal, and turf in different parts of the canton. The manufactures of linen and cotton are considerable; there are also a few tanneries and glass manufactories.

Nearly two-thirds of the inhabitants are Roman Catholics; the rest are Protestants. The canton of St. Gall sends eight members to the National Council. Its local government is one of the most democratic in Switzerland.

GALL, ST., the capital of the above canton, once a free imperial city, situated in a pleasant valley, is well built and supplied with water, and contained 21,204 inhabitants in 1880. A magnificent abbey was erected here in the seventh century by Pepin l'Heristal over the tomb of a monk called Gallus (St. Gall), a missionary from Ireland who had converted the land. It was one of the oldest ecclesiastical establishments in Germany, and became the asylum of learning during the dark ages, being one of the most celebrated schools in Europe between the eighth and tenth centuries. Here the works of the authors of Greece and Rome were not only read but copied, and we owe to the labour of these obscure monks the works of some of the most valuable classical authors—Quintilian, Petronius Arbiter, Silius Italicus, and Valerius Flaccus having been printed from MSS. found here in 1413. The library, which now belongs to the town, occupies a fine apartment, and besides its literary treasures has some busts, portraits, and a cabinet of mineralogy. The abbey church is now the cathedral of the diocese of St. Gall; the ancient palace of the abbots (*die Pfalz*) at present serves for the public offices of the cantonal government; and the other buildings of the monastery have been appropriated to the Catholic gymnasium. The abbey was secularized after the French revolution, and in 1805 its revenues were sequestrated.

The abbots of St. Gall about the tenth century began to assume a military character, and surrounded the convent with walls and ditches. From the thirteenth century they enlarged their dominions at the expense of their neighbours, and becoming the most considerable territorial sovereigns in Northern Switzerland, were raised to the rank of princes of the empire. Early in the fifteenth century, however, Appenzell threw off their yoke, and at the Reformation the town of St. Gall emancipated itself from their control, and acquired a territory of its own. The town was first incorporated in the tenth century; in 1454 it allied itself with the free Swiss cantons, and sent a deputy to the diet; and at the end of the seventeenth century its civil and political independence was secured. Since 1846 St. Gall has been an episcopal see. St. Gall is now one of the most flourishing towns of Switzerland. It has Protestant and Roman Catholic gymnasia, learned and other associations, and collections in art and science, manufactures of muslins and cotton yarn, and a trade in the produce of the eastern Swiss cantons. The red wine made in the neighbourhood is among the best in Switzerland.

GALL STONES, concretions composed chiefly of cholesterin and the bile pigments found in the gall-bladder, biliary passages, or the cystic and common ducts. They are exceedingly rare in infancy and childhood, but become more common after thirty. Their origin is somewhat obscure, but it seems to be favoured by rich diet and a sedentary mode of life. While in the gall-bladder they cause little or no inconvenience, but when they leave it they cause violent pain, vomiting, and great constitutional disturbance. When they reach the intestines the attack passes off and the patient recovers. Occasionally, but very rarely, the obstruction is sufficient to cause death. During an attack of gall-stone colic the efforts of the physician are directed to the alleviation of the pain, and the patient may be placed in a warm bath and the heat sustained by the renewal of the water. As a preventive of further attacks a mixture of ether and turpentine, three parts of the former to two of the latter, has been recommended, and alkaline mineral waters have also been employed with advantage.

GALLE, or POINT DE GALLE, a town of Ceylon, on the S.W., 80° 14′ E. lon., 6° 1′ N. lat. It is a station for steamboats, and has a population of 50,000. The climate is healthy. It consists chiefly of public buildings,

which include the fort, about a mile in circuit, the post office, barracks, lighthouse, a handsome English church, a Dutch church, and hotels. The private houses are one storey high, furnished with verandahs, which run along the entire frontage, and the number of trees and other brilliant vegetation render the place a very beautiful one. The roads forming the outer harbour are spacious, but they are subject to the south-west monsoons. The improvements effected at Colombo have, however, much injured the trade of the port. The town has telegraphic communication with India, Europe, and Australia. Galle has been identified by some with the Tarshish of Solomon, and also with the *Avium Promontorium* of Ptolemy, but without much basis for the conjecture. The name Galle was really derived from the Cingalese *galla*, signifying a rock, though the Dutch and Portugese assumed wrongly that it was from the Latin *gallus*, a cock.

GAL'LEON (*galeon* in Spanish) was the name given to very large armed merchant ships, with three or four decks which the court of Spain used to send to the coasts of Mexico and Peru, to receive on board the gold and silver bullion extracted from the mines, and bring it to Spain. The word comes from GALLEY.

GALLERY, in its most extended sense, is used synonymously with corridor. In England, however, it is understood to be either a long narrow passage-way or an open space, generally longer than wide, raised above the floor of a building, and usually supported by columns. Such galleries are met with (among other places) in English churches, in some courts of justice, and in theatres. The long external wooden passages, formed something like a balcony, such as are occasionally seen in old inns, are likewise called galleries.

Gallery is also a name of distinction given to a room either on account of its extent and proportions, or to one or more rooms especially appropriated to pictures and other works of art, whence the term gallery is extended to the collection itself, without any reference to the building. In architectural language a room can hardly be called a gallery unless its length be three times its width, though that length may be increased to any extent not out of keeping with the other apartments, as was generally the case in Elizabethan mansions. A very long gallery will bear to be somewhat loftier than one of moderate length; but the height must not be such as to occasion the effect of narrowness, and produce the proportions of a mere corridor. Very low proportions are characteristic of galleries of the Elizabethan period, which look quite depressed by their heavy flat ceilings.

There is hardly anything in the interior of a building which lends itself so readily to architectural effect as a gallery, by giving lengthened perspective and vista; and when the gallery is formed into divisions, many fresh and rich combinations of f[illegible]n are obtainable. Thus at Holkham, in Norfolk, the seat of the Earl of Leicester, there is a singularly beautiful statue gallery, formed by two octagons and a centre, connected by open arches. The arrangement of galleries in tiers one over the other, now so much used in churches, chapels, theatres, and places of amusement, is entirely modern, dating from the seventeenth century.

Gallery, in military mining, is a subterranean trench or passage leading to the place where the powder is deposited for the purpose of producing an explosion.

Of the galleries which appertain to a fortress the principal one, denominated the magistral gallery, surrounds the place under its covered way; and the entrances to it are in the counterscarp of the ditch. A second gallery, designated the envelope, is formed under the foot of the glacis, so as either wholly or partially to circumscribe the works; and galleries of communication under the glacis lead to it from the former gallery. Small galleries, sometimes called listeners, are also carried towards the country from the envelope, in order, as the name implies, that the defenders in them may discover by the sound where the enemy's miner is at work.

The galleries of a fortress are at least 6 feet high and 4 wide, and are lined and vaulted with brickwork; they are, or should be, so disposed as to insure complete drainage, and means must be provided to afford them proper ventilation. At the places where the galleries of communication fall into the envelope are placed strong doors, with loopholes through them for musketry, in order to arrest the progress of an enemy, should he force an entrance into the envelope.

The word is also used for the excavated or constructed galleries at those parts of the great mountain roads which are exposed to avalanches or to torrents. The Stelvio and the Simplon roads present splendid examples of both.

GALLEY (*galère* in French, *galèra* in Italian and Spanish), a large-sized, long, and narrow vessel propelled by oars and sails, which until the end of the eighteenth century was much in use in the Mediterranean for coast navigation, and for making the shore in shallow water. The oars were a great advantage before the introduction of the steamboat in the dead calms so frequent in the Mediterranean. The largest galleys were 166 feet long and about 32 wide, with fifty-two oars. The rowers, who were generally convicts or Turkish prisoners, sat on benches on the deck, with chains to their feet. The ship, besides carrying a 24-pounder, usually carried two 8-pounders. The Venetians had a sort of large galley, with a very lofty poop, called *galeazza*. Small galleys were called *galliots*.

Galley is also the name of a slight swift boat carried by a modern man-of-war. The name is likewise given to the general cooking place on board a ship.

GALLEY SLAVES (*galériens* in French, *galeotti* in Italian) was the name given to criminals condemned to hard labour, who formerly used to be employed as rowers on board the galleys. Convict galleys in France were abolished in favour of BAGNES.

GALL-FLY is the name given to the species of the Cynipidæ, a family of hymenopterous insects belonging to the group PUPIVORA. The gall-flies find their nearest allies in the ichneumon flies. While the latter, however, deposit their eggs within the living bodies of other insects, the eggs of the gall-flies are deposited in punctures made in leaves, stems, and other parts of plants, causing tumour-like growths known as GALLS. Within these galls the egg is hatched, and the insect in some cases remains till the perfect condition is to be assumed. Sometimes the larva feeds on the juices of the gall until it is full grown, when it eats its way out of its nest, falls to the ground, and passes through its metamorphoses under the surface. The gall may have several cavities or cells within it, each of which is inhabited by a grub. Among the galls caused by these insects may be mentioned the well-known oak-apples, the symbol of loyalty on the 29th of May, the cherry-galls, currant-galls, spangle-galls (all found on various parts of the oak), and the bedeguar, the little ball of moss found on the stems of roses.

Some gall-flies play the part of the cuckoo among birds, depositing their eggs in the galls produced by other species. Most of these cuckoo-like parasites belong to the genus Synergus. Some of this family, however, are truly parasitic, laying their eggs like the ichneumon-flies in the bodies of other insects, particularly larvæ. Examples of parasitic species are to be found in the genera Ibalia, Figites, and Allotria. The larvæ of many gall-flies again are the unwilling hosts of parasitic insects belonging to other families. Many ichneumon-flies deposit their eggs in the body of the little grub inclosed in the heart of its gall. Species of the family Chalcididæ, which have long bristle-like ovipositors, have similar habits; species of Callimome haunt the cherry-

galls of oaks and the bedeguar of the rose. Other insects may be found in galls, beetles, flies, caterpillars of moths, &c., all parasites.

The reproduction of the gall-flies is remarkable. The females far outnumber the males; the males of some species are still unknown, those of other species have only recently been discovered. An alternation of generations takes place, one generation being produced asexually. According to Dr. Adler of Schleswig the generations produced sexually are only transitory forms, producing galls quite different from those from which they themselves issued, and giving origin to both male and female insects, differing so in form and structure from the parent forms as to be placed in different genera. For instance, the common species *Spathegaster baccarum*, which issues from the currant-galls, presents male and female individuals with rather short ovipositors. But the galls produced by the females are the small spangle-galls. From these galls proceed *Neuroterus lenticularis*, of which only females are known, having a very long ovipositor. These gall-flies emerge in the winter, and lay their eggs in the buds of the oaks in March and April, thereby causing the formation of the currant-galls, from which Spathegaster, both male and female, is produced. Dr. Adler has discovered that a similar relation exists between several other species of Cynipidæ.

The gall-flies are small insects with four large wings, having few veins and frequently glowing with the most beautiful colours. The abdomen is short and usually strongly compressed; the first two segments are greatly developed, the remainder are retracted within these and conceal the partially coiled ovipositor. The antennæ are of equal thickness from the base to the apex (or with the latter portion slightly thickened), and consist of from thirteen to sixteen joints. The males have one joint more to the antennæ than the females.

GAL'LIA. See GAUL.

GAL'LIARD, an antique dance of a lively character, so called from its gay rhythm. It was the predecessor of the minuet, and while sprightly, "with lofty turns and caprioles in the air," was not rapid, although a contemporary poet (Sir J. Davis), used to the solemn dances of an earlier time, calls it a

> "Swift and wandering dance
> With passages uncertain to and fro."

Its heyday of favour was under Queen Elizabeth and the early Stuarts; and "Now, oh now, we needs must part," the beautiful song of Dowland, is believed to have been used as one of the favourite tunes. The galliard was danced, like the minuet, by couples, not by the entire company, as the country-dance, though of course as many couples as chose might dance at the same time; it was in 3-4 time. Some specimens in common time exist, but possibly they were instrumental pieces in galliard style.

GALLIC ACID. This organic acid is found in a number of plants, especially in those having astringent properties. Gall-nuts, acorns, tea leaves, hellebore, sumach, and oak bark are common instances. The principal source is the gall-nut, from which the name is derived. It is usually prepared from this source in quantity by the slow decomposition of the tannin in exposing the powdered galls to air and moisture. It was discovered by Scheele. The formula is $C_7H_6O_5$. Gallic acid crystallizes in long silky needles; it is very soluble in alcohol and in hot water; it is a true acid, and forms a number of metallic and other salts known as gallates.

When heated to 215° C. (419° Fahr.) it decomposes into carbonic acid and pyrogallic acid ($C_6H_6O_3$). This acid is a good deal used as a developer in photography, and as a means of abstracting oxygen in gas analysis. Gallic acid is used in medicine as an astringent. It differs from tannin in not precipitating solutions of gelatin. It gives a deep blue colour with salts of iron.

GAL'LICAN CHURCH, the Church of France. This church is one of great antiquity, the principles of Christianity having been diffused in France before the end of the apostolic period. It gave many noble confessors to the army of martyrs during the persecutions instituted by the Roman emperors, and eminent writers arose from its ranks during patristic times, the most celebrated among the latter being Irenæus, bishop of Lyons. This church also appears to have been well organized from the earliest period, and many bishops were present at the Council of Arles in the year 314 A.D. representing sees that are still called by the same names in the French episcopacy. During the mediæval period the Church of France was ever one of the first in offering opposition to the growing claims of the Roman pontiffs, relying for its support upon the power and authority of the crown. Many conflicts between the rival claims of pope and king are recorded in the history of France, and as the French Church for the most part sided with the king, the term Gallican became synonymous with that system of theology and ecclesiastical discipline which, while recognizing the spiritual authority of the pope, yet maintained the superior authority of a general council, and refused to recognize papal authority as extending to temporal affairs.

Of these contests the most important is that which arose towards the close of the seventeenth century during the reign of Louis XIV., the papal chair at that period being occupied by Innocent XI. The question which then formed the front of the controversy was in relation to the *Droit de Régale*, or the right claimed by the king to administer the affairs of a vacant see, which was contested by the pope. A council of the French clergy was called by the king, in 1682, to consider this question with other matters relating to the connection of the spiritual and temporal powers in ecclesiastical affairs. The leading spirit of this council was the celebrated BOSSUET, and under his influence a series of articles, termed the "Declaration of the Gallican Church," were drawn up, which received the assent of the whole council. The important points of this declaration are, (1) the assertion of the radical distinction between the spiritual and temporal powers, and the independence of the king in all that relates to civil and temporal affairs; (2) that in conformity with the Council of Constance the decision of a general council is superior to that of the pope; (3) that the decision of the pope is not unalterable, that the usage of individual churches should be recognized by the pope, and "that the rules, customs, and institutions of the Gallican kingdom and church remain in full force."

This celebrated document, which has ever since been regarded as the charter of Gallicanism, was zealously supported by Louis XIV., but it was repeatedly condemned by the popes, and ultimately a working compromise between the opposing claims was adopted. During the period subsequent to the French Revolution, however, a great change took place in the feeling of the French clergy in this matter, and they became more disposed to side with the pope in the conflicts arising between civil and ecclesiastical authority. This change was illustrated in a striking manner at the Vatican council of 1869–70, when the French bishops were among the foremost advocates of the supremacy of the pope and of the doctrine of papal infallibility. Ultramontanism has since that council quite taken the place of Gallicanism in France, and the recent changes in the government of that country have tended to intensify the alteration. Under the republic the privileges of the church have been seriously curtailed, and a strong anticlerical feeling has been displayed by the Chamber on several occasions. Under these circumstances the attitude of the clergy towards the state has become rather that of

fear and guarded opposition than one of reliance, and at the same time the bonds of union with the Church of Rome have been intensified and strengthened.

GALLIE'NUS, Emperor of Rome, son of the Emperor Valerianus, was made Cæsar and colleague to his father in 253. His full name was Publius Licinius Valerianus Egnatius Gallienus. He defeated, near Milan, the Alemanni and other northern tribes which had made an irruption into North Italy. He was well informed in literature, and was both an orator and a poet. When Valerianus was taken prisoner by the Persians in 260, Gallienus was acknowledged as Augustus. He appears to have given himself up to debauchery, neglecting the interests of the empire. Usurpers arose in Egypt, among the Gauls, in Thrace, in almost every province of the empire, from which circumstance this period has been styled the reign of the thirty tyrants. At the same time a fearful plague decimated Rome. While besieging Aureolus, one of the usurpers, in Milan, Gallienus was murdered by some conspirators in 268. He was succeeded by Claudius II.

GALLI'NÆ (game birds) is an order of BIRDS of which the domestic fowl may be taken as the type. These birds are usually of moderate or rather large size, and of a stout and rather heavy form. They have a small head, often partially or wholly denuded of feathers, and a bill of moderate length, of which the upper mandible is distinctly arched, and overhangs the lower one both at the tip and along the margins. The nostrils are placed on the sides of the bill, and are covered with a soft skin. As the Gallinæ are all essentially terrestrial in their habits, the legs are always strong and well developed. The tarsi are stout, and very commonly armed with a spur, or even with two or more such weapons, which are especially developed in the males; the toes are three in front and one behind, the latter being usually small and slightly elevated upon the back of the tarsus, but sometimes more elongated, and then placed upon the same plane as the anterior toes, so as to render it more efficient in grasping. The anterior toes are not very long, but stout, and often united by webs at the base; they are armed with strong and rather blunt nails, which are of great service to the birds in scratching in the ground in search of food, a habit common to most of the species. Hence many ornithologists give these birds the name of Rasores or Scrapers. The feathers of the legs are continued down to the articulation of the tarsus, and sometimes extend beyond this point even to the

The Impeyan Pheasant (*Lophophorus Impeyanus*).

extremities of the toes. The wings are generally short and weak in comparison with the weight of the birds, so that they fly heavily, and only to short distances. Their plumage is firm, and often adorned with brilliant tints, and some parts of it, especially in the males, are frequently developed to an extraordinary extent, giving the birds sometimes a grotesque, and sometimes an elegant appearance. The plumage of the sexes often varies greatly, as in the pheasants (see cut) and peacocks. The head of the male is frequently adorned with crests, combs, and wattles, which appendages in the breeding season grow larger or more brilliant in hue. The superior adornment of the male birds, which is so marked a feature of this order, is explained by Darwin ("Descent of Man") on his theory of sexual selection.

The game birds are spread over all parts of the world, but the finest species are inhabitants of the warmer regions. Their food consists of fruits, seeds, herbage, insects, and worms. They are generally polygamous in their habits, each male collecting around him a seraglio as numerous as he can keep together. In keeping off the attentions of rivals he is frequently engaged in almost incessant

combats. The females lay their eggs, which are generally numerous, upon the ground, in some sheltered situation. The curassows build their nests in trees. The young are usually able to run as soon as they leave the egg; but at night, or on the approach of danger, they shelter themselves under the wings of their mother.

The Gallinæ are divided into the following families:—Phasianidæ, with the subfamilies Pavoninæ (peacocks) and Phasianinæ (pheasants: see Plate, figs. 1–3), Numidinæ (guinea-fowl, fig. 4) and Meleagrinæ (turkeys); Megapodidæ (mound-birds, fig. 5); Cracidæ (curassows, fig. 7); Opisthoconidæ (hoatzins); Tetraonidæ, with the subfamilies Tetraoninæ (grouse) and Perdicinæ (partridges, figs. 8, 9); Pteroclidæ (sand-grouse); Turnicidæ (hemipodes); Chionidæ (sheathbills, fig. 10); Tinamidæ (tinamous). The position of the last two families is doubtful, and they are removed by some from this order.

GAL'LINULE. See MOOR-HEN.

GALLIP'OLI, a seaport town of Turkey, is situated on a peninsula at the north-eastern extremity, and on the European side of the Strait of Dardanelles, and lies nearly opposite to Lampsaki, the ancient *Lampsacus*, on the Asiatic side of the channel. It occupies a considerable space, but the streets are ill-built and dirty; the bazaars, however, are extensive and well supplied. Gallipoli was the first European town which fell into the hands of the Turks. They took it in 1357, on which occasion the Emperor John Paleologus observed that he had only lost a jar of wine and a sty for hogs, alluding to the magazines and cellars built by Justinian. Bajazet I., however, knowing its importance for passing from Prussa to Adrianople, had it repaired and strengthened, and its port improved. It has two harbours, in which the imperial fleets frequently lie at anchor. The population, consisting of Turks, Greeks, Armenians, and Jews, amounts to 30,000. Its trade consists in corn, wine, and oil. There are several ancient remains in the town and neighbourhood, the most remarkable of which are the magazine and cellars of Justinian, and the tumuli to the south of the city, which are said to be the tombs of the ancient Thracian kings. A part of the Anglo-French army, for the protection of Turkey, landed here in 1854. Near the town is an exceedingly strong position, known as the lines of Bulair, the fortifications of which were greatly improved and strengthened in 1878, when Constantinople was in danger from the Russians. The district of the peninsula of Gallipoli, which is the ancient *Chersonesus Thracica*, is very fertile, and considerable quantities of cereals, wine, oil, and sheep are exported.

GALLIP'OLI, a fortified seaport town of South Italy, in the province and 29 miles W.S.W. of the town of Lecce, situated on an islet in the Gulf of Taranto, connected with its suburb, Lizza, on the mainland, by a bridge. It has a good roadstead and harbour, with from 10 to 12 fathoms of water. The port is one of the most frequented in South Italy, being the great mart for the oil of Apulia. It is noted for its ample cisterns, cut in the rock, which are peculiarly adapted for clarifying oil, the chief product of the country. The population of the town is 11,000. It has a cathedral, a castle, and schools; manufactures of muslins, woollens, and cotton hosiery; a tunny fishery, and an active trade in corn, wine, and fruits. Gallipoli is very probably on the site of the Callipolis, "the beautiful city," said to have been founded by a Spartan named Leucippus and some citizens of Tarentum. It is said to have received Christianity as early as 44 A.D.

GAL'LIUM. This new metal was first discovered by M. Lecoq de Boisbaudran by spectrum analysis. He found it in minute quantity in the zincblende of Pierrefitte in the Pyrenees. It has also been found in zincblendes from Asturias and Bensberg. The latter is the richest source, but it contains only 16 milligrammes of the metal in a kilogramme. The discoverer exhibited 62 grammes of the new metal in the Paris Exhibition of 1878, which he had extracted from 2400 kilogrammes of zincblende.

The metal is usually obtained from the ore by throwing it down with other foreign metals by metallic zinc. It is separated from the other metals by fractional precipitation with sodium carbonate; the precipitate is dissolved in sulphuric acid, and the gallium crystallized out as basic gallium sulphate. The metal is isolated by electrolysis.

Metallic gallium is bluish-white in colour, and fuses readily at 30° C. (86° Fahr.) In fact it melts in the hand. The melted metal resembles silver, and has the remarkable property of remaining liquid for a long time at ordinary temperatures down to zero, but it at once solidifies on being touched with a piece of the solid metal.

The atomic weight is 69 and the symbol Ga; specific gravity, 5·9. It is crystalline, and may be cut with a knife, though rather tough. It is not volatilized at a red heat, and gives a bright mirror on glass. It dissolves readily in caustic potash and dilute hydrochloric acid with evolution of hydrogen, but not in dilute nitric acid. Gallium does not readily oxidize even at a high temperature, but it tarnishes on exposure to air.

Oxide of gallium, Ga_2O_3, is an insoluble white precipitate, soluble in ammonia and very soluble in potash. Gallium chloride, Ga_2Cl_6, is very deliquescent; concentrated solutions become turbid on addition of water, from the formation of a basic salt. Gallium sulphate, $Ga_2(SO_4)_3$, is a very soluble salt, depositing basic sulphate on boiling. It combines with ammonium sulphate to form a crystalline alum, having the formula $Ga_2(SO_4)_3 + (NH_4)_2SO_4 + 24H_2O$. Gallium is recognized in spectrum analysis by two bright violet lines. Neither the metal nor its salts are of any practical importance.

GALLON, an old English measure of capacity. Distinct gallons for wine, ale and beer, and corn and dry goods, continued in use until the Act of 5 Geo. IV. c. 74, which came into operation 1st May, 1825. By statutes of 1689 and 1697 the wine gallon was declared to contain 231 cubic inches. The ale gallon was measured in 1700 or thereabouts, and found to contain 282 cubic inches. The corn gallon was thought, in the middle of the last century, to contain exactly 272¼ cubic inches; but the statute of 1697, which declares that a round corn-bushel must be 8 inches deep and 18½ inches wide, had in fact fixed the gallon at $268\frac{8}{10}$ cubic inches. The imperial gallon now in use as the standard measure of capacity for all liquids and for dry goods, as settled by Act of Parliament in 1826, contains 277·274 cubic inches, or 10 pounds avoirdupois of distilled water at the temperature of 62° Fahr., the barometer being at 30 inches.

GALLO-TANNIC ACID. See TANNIN.

GAL'LOWAY (called by the Latin writers of the middle ages *Galloridia*) is a district in the south-west of Scotland, which once included the country lying between the friths of Solway and Clyde, but is now confined to the two counties of Kirkcudbright and Wigtown. The designation, though long used, implies no political jurisdiction. At the south-western extremity is the promontory called the Mull of Galloway, having a lighthouse 325 feet above the sea, and which can be seen at a distance of 21 nautical miles. The general appearance of the district is rugged and mountainous, producing little else than pasturage for sheep and cattle, which are bred in large numbers, principally for the supply of the English market. The small horses known by the name of Galloways are also bred here.

Galloway seems first to have been inhabited by a semi-independent people called by Bede the Niduari. It next formed for several centuries a portion of the Anglian kingdom of Northumbria, and is said to have gained its present name from being ruled over by foreigners, through the word *gall*, which means a stranger. About the ninth century it appears to have been separated from Northumbria,

and to have been known as the land of the Picts. It was at this time ruled by its own chieftains, and it was not until the last of these, Alan of Galloway, constable of Scotland, died in 1233 that the district became really subject to the Scotch crown.

GALLS have been defined as "all abnormal vegetable productions developed on plants by the action of animals, more particularly by insects, whatever may be their form, bulk, or situation." The galls formed by insects are by far the most numerous. These galls are the result of morbid growth induced in the tissues of the plant by the deposition of the insect's egg. The insect punctures some portion of the plant with her ovipositor, and in the wound thus made deposits an egg, together with a drop of some irritating fluid. This fluid is the exciting cause of the active growth that takes place in the tissues of the part attacked. A sort of tumour, varying greatly in size, shape, and consistency, is formed inclosing the egg. Within this gall the egg is hatched. The larva, a fat little grub, lies curled up in its cell, feeding on the juices of the gall, and breathing the air that gets in through the minute pores of the gall. In many instances when the larva has attained its full growth it eats its way out of the gall, and falling on the earth burrows beneath the surface, and there spends its pupal existence. Sometimes, however, it undergoes all its metamorphoses within the gall, emerging as the perfect insect. Some galls contain only one cavity and one grub; others contain many cells, each of which has its inmate. The size of the gall is, however, no criterion of the number of its inhabitants, for some of the largest have only a single cell.

Galls are made by various insects. The best known are due to species of the family Cynipidæ, to which the name GALL-FLY is usually restricted. This family belongs to the order Hymenoptera, and is nearly allied to the ichneumon-flies. The oak is the tree specially attacked by the insects of this family. No part of the tree escapes the presence of a gall of some sort—the leaves, flowers, branches, stems, trunk, and even the roots bearing these excrescences, which do not appear to injure the tree in any way. The common oak-apple—the symbol of loyalty on the 29th of May, King Charles' Day—is produced by *Cynips terminalis.* The oak-apple is a large, hard, globular, many-celled gall. The cherry-galls of the oak leaves are due to *Cynips quercusfolii.* These galls are round and smooth like an apple, succulent and beautifully coloured, and contain only one gall. The largest British galls are produced by *Cynips kollari*, and are found in clusters on oak branches. They are large, hard, brown, spherical, single-celled galls. They were unknown in England till 1847, but are now almost the most common. Spangle-galls are small flat discs, found on oak leaves, and often mistaken for fungi. The red and green currant-galls, hanging on long strings from the catkins of the oak, are produced by a species of gall-fly. *Biorhiza aptera*, a species of the same family, forms galls on the roots of oaks. The oak-gall of commerce is produced by *Cynips tinctoria*. The celebrated Dead Sea apples have been regarded, but erroneously, as the oak-galls of *Cynips insana*. A singular gall is produced on the stems of roses by *Rhodites rosæ*, one of this family. This gall, the bedeguar, is of an irregular shape, and contains many larvæ. The exterior is covered thickly with long branching hairs, giving it the appearance of a ball of moss. These hairs represent leaves which have been developed with scarcely any tissue between their ribs.

Gall-like excrescences are formed by a few other hymenopterous insects, some species of the families Chalcididæ and Tenthredinidæ (saw-flies).

Among the Diptera, or two-winged flies, the chief gall-makers are species of the family Cecidomyidæ, beautiful little gnat-like insects, commonly called gall-midges or gall-gnats. Most of the galls on species of willow are due to these gall-midges. The wart-like galls common on the meadow-sweet, the uneven swellings on the stalks and leaves of the stinging-nettle, the little furry purses on the ground-ivy, the woody shapeless excrescences on the raspberry plants, the slender upright growth on beech leaves, the blisters on bedstraw, yellow nettle, and others, the knots within the very blossoms of many flowers—all these, and a great many more, are the work of these gall-midges (Staveley).

In the Hemiptera gall-makers belong to the families Tingidæ, Psyllidæ, Coccidæ (scale insects), and Aphidæ (plant-lice). The curious Chinese galls of commerce are produced by a species of the last family, *Aphis chinensis* or *Rhus semialata*, a tree belonging to the order Anacardiaceæ, or cashew tribe. These galls are somewhat pear-shaped, with irregular branching, covered externally with a fine gray down. The walls are very thin, and burst to permit the escape of the perfect insect.

Among the beetles (Coleoptera) a few gall-makers are found, species of the families Curculionidæ (weevils), Lamiidæ, and Sagridæ. Of the Lepidoptera, species of the families Ægeriidæ, Tortricidæ, Tineidæ, and Pterophoridæ form galls.

Gall-like excrescences on the leaves of plants are caused by species of Phytoptus, a genus of Acaridea, or mites. These mite-galls, as they are called, occur on the sycamore, pear, plum, vine, and other trees. The "witch-knot" of the birch, which looks like a bird's nest made of twigs, is an abnormal growth of some years, caused by these mites. Species of Nematoid worms, as Anguillula, also cause galls on plants.

Galls were well known to the ancients, being mentioned by Theophrastus and Pliny. Their origin was unknown till quite recently. Even Bacon could describe oak-apples as "an exudation of plants joined with putrefaction."

The galls of commerce are chiefly those which occur on the *Quercus infectoria*, and are due to *Cynips tinctoria.* They vary in size from that of a pea to that of a nutmeg. The surface has irregular elevations or lines, with the interspaces generally smooth. The colour is white or yellow in one variety; green, gray, or black in another. The white variety, which is the largest, has a hole in the substance of the shell, by which the larva has escaped. This kind is the least powerful and least esteemed. The best galls come from Aleppo and Smyrna, but are often mixed with those from Syria and Cyprus.

Galls are the source of tannin and gallic acid. The infusion possesses all the valuable properties of the gall, as does an alcoholic tincture; but the decoction is an objectionable preparation. For internal use the infusion is preferable to the powder. Galls may be employed in powder to form an ointment, which with opium and camphor is of great service in painful hæmorrhoids. As a tonic in intermittent fever, and as an astringent in hæmorrhagic discharges, galls are occasionally employed. But the most extensive use is made of them in the arts, as a chemical test, and in the manufacture of ink.

GAL'LUS, a favourite family name with more than one of the great *gentes* or clans of ancient Rome.

The Emperor C. Vibius Trebonianus Gallus (251-254) served under Decius against the Goths, and when Decius fell in battle, it is believed, by his treachery, he succeeded to the throne. He purchased peace with the Goths, and so cowardly and dishonourable a commander did he prove, that eventually his own soldiers slew him.

Of the other noteworthy Romans with this name may be mentioned the great lawyer, C. Aquilius Gallus, the teacher of Cicero, and often cited in the Digest; and Ælius Gallus, also distinguished in the law, his contemporary. C. Cornelius Gallus, the friend and protector of Virgil during the Civil War, was himself so notable a poet that Ovid gives him the first place among writers of elegiacs. He rose to

great favour with Octavian, and was prefect of Egypt after the battle of Actium for four years. He incurred severe disgrace, the reason of which is not known, and rather than survive it, he threw himself on his own sword and expired, B.C. 26. L. Asinius Gallus Saloninus, consul B.C. 8, married Vipsania, the divorced wife of the Emperor Tiberius, and was upon some pretext imprisoned in consequence, and allowed slowly to starve, A.D. 33. Cestius Gallus was legate of Syria in 61, when the Jews rebelled and the troubles ending in the destruction of Jerusalem by Titus began.

GALOFA'RO, or **CAPE DE GARO** (the ancient *Charybdis*), a whirlpool in the strait, and outside the harbour, of Messina, Sicily. Opposite it, on the Italian side, is the rock of Scylla.

GALOP (French, the swiftest pace of the horse), the title of a round dance, whose name indicates its rapid flying character. It is danced to a swift duple rhythm in 2-4 time, as fast as possible. It also forms part of other dances, as of quadrilles. Though it is of German origin it comes to us from the French, with whom it has been a favourite since the early part of the century. The word was originally *wallop*, in which form it represented the bubbling sound of boiling water. We had till quite recently as one of our political franchises the *potwallopers*, or boilers of the domestic pot, *i.e.* householders. The horse's feet seemed to wallop like the water in the pot to our far-off ancestors.

GALVA'NI, ALOYSIUS (Lewis), was descended from a respectable family of Bologna, which had produced several distinguished men of letters. He was born in that town in 1737, and studied in its university. The degree of M.D. was conferred on him in 1762, and he received the appointment of lecturer on medicine at the institute of his native town. In the *Memoirs* of this body we find contributions on various medical subjects by Galvani. He also published separately "Observations on the Urinary Organs" and "On the Organs of Hearing in Birds;" but an accidental circumstance is said to have introduced him to a subject which excited deep attention throughout Europe, and gave birth to a new and fruitful branch of physics, which yet retains in all countries the name of its first observer. There is evidence, however, that the matter had been studied by him long before this incident.

During his temporary absence, his wife, who was about to prepare some soup from frogs, having taken off their skins, laid them on a table near the conductor of an electrical machine which had been recently charged. She was much surprised, upon touching them with the scalpel (which must have received a charge from the machine) to observe the muscles of the frogs strongly convulsed: she acquainted him with the fact upon his return. Galvani repeated the experiment, and having varied it in several ways he was led to conclude that there existed an animal electricity both in nerves and muscles. Some future experiments appearing favourable to that erroneous inference, he seems to have clung to the opinion during the remainder of his life, notwithstanding the experiments of Volta and others, which showed, at least, that the moisture on the surface of the frog acted as a conductor.

The work in which Galvani developed his views relative to this new class of phenomena was published in 1791, under the title "Aloysii Galvani de Viribus Electricitatis in Motu Musculari Commentarius," in which he infers, that the bodies of animals possess a peculiar kind of electricity, by which motion is communicated by nerve to muscle, and in these experiments he regarded the metals as acting only as conductors between these substances, which, he thought, accounted for the observed contractions of the muscle, in the same manner that the dissimilar electricities on the interior and exterior surfaces of a Leyden jar reunite with explosion through a metallic conductor. In 1797 Galvani made a voyage along the shores of the Adriatic, for the purpose of confirming his notions on animal electricity by experiments on the gymnotus, from which he concluded that the brain contributed to produce the observed effects. During the occupation of Italy by the French he was expelled from the offices which he held, because he refused the prescribed oaths when Bologna formed a part of the Cisalpine republic. He died in 1798.

GAL'VANISM. See VOLTAIC ELECTRICITY.

GALVANIZED IRON. On dipping clean iron into melted zinc a thin film of the latter adheres to the iron. This coating is an effectual protection against the rusting action of the atmosphere. Iron thus prepared is called galvanized iron, which is a somewhat misleading name, as the adhesion is not caused by galvanic action of any kind. There is also another similar arrangement called galvanized iron-tin. In its preparation the plates, or sheets of iron, are first dipped into melted zinc, and then into melted tin. The protection of the iron from oxidation is attributed to a galvanic current set up between the two metals. This material is manufactured into a variety of articles, and is of very general use in the arts, being more durable and stronger than zinc or lead, and much better than plain iron, when rust is to be avoided. From these galvanized plates, buildings of various kinds, from the humble cabin to a stately church or council-hall, have been constructed for exportation. The various plates are duly numbered, and closely packed for their destination, and in a very few days after their arrival they assume the shape of comfortable domiciles or commodious public edifices. But the utility of this material is not confined to the external parts of buildings. It is adopted for various kinds of vessels and household utensils. In another form there are plain plates for roofing, and for the sides and doors of houses; roofs for sheds, roofs and sides for storehouses, and many similar purposes. Then, beside the sheet form, there are round and square bars, hoop iron, wire, tubes and pipes, nails, rivets, bolts, screws, all formed of iron thus protected by the galvano-tin process. There is this advantage also, which is unattainable by the ordinary tin-plate process, that articles, provided they are of small dimensions, can be tinned after they are made in the proper form of iron.

GALVANOM'ETER. See VOLTAIC ELECTRICITY.

GAL'VESTON, a seaport town and the chief city of Texas, in the United States of America, on the eastern extremity of Galveston Island, at the entrance of Galveston Bay, Gulf of Mexico. The population in 1880 was 22,500. The harbour is the finest in the state, but its entrance is encumbered by a sandbar, so that vessels drawing more than 12 feet cannot enter; it is intended, however, to construct works which will increase the depth of water. Galveston is the centre of an extensive and growing cotton trade, and it has also some commerce in wool, hides, cattle, pecan-nuts, and beeswax. It is a well-built healthy town, with regular streets, numerous churches and schools, the usual public offices and institutions, and a Roman Catholic university and cathedral. There is good railway accommodation, and steamers ply daily to New Orleans. Galveston Island was from 1817 to 1821 the haunt of the pirate Lafitte.

GAL'WAY, a county of Ireland, in the province of Connaught, is bounded W. by the Atlantic Ocean, E. by King's County and Tipperary, N. by Mayo, N.E. by Roscommon, and S. by Clare and Galway Bay. It extends from 52° 57′ to 53° 42′ N. lat., and from 7° 53′ to 10° 15′ W. lon. The average length, east to west, is about 80 miles; the greatest breadth, north to south, 62 miles. The area is 1,566,354 acres. The population in 1881 was 241,662.

The greater part of Galway is comparatively flat, and much of it encumbered with bogs. Lough Corrib, which divides the county into the east and west districts, is

80 feet above the level of the sea, and occupies an area of 43,485 acres. Lough Derg is an expansion of the Shannon, and forms part of the south-western boundary of the county. The whole district west of Lough Corrib and Lough Mask is known by the names of Connemara, Iar-Connaught, and Joyce's Country, and has of late years attracted much attention by its capabilities of improvement, as well as by the uncommon wildness and beauty of its scenery. The district is about 40 miles long by 30 broad. It has many conical mountains and small lakes. The islands off the coast of Galway are very numerous; the chief are the three islands of Arran, lying about midway between the coasts of Connemara and Clare, in the opening of the Bay of Galway. Inisbmore, or Arranmore, the largest of these islands, is about 7 miles long by two broad; the other two, Inishmaan and Inishere, are much smaller. Along the same coast are the islands of Inishturk, Inishboffin, and Inishark.

On the southern side of the Bay of Galway the coast is not favourable for the construction of harbours. Westward, however, from Galway, and round the entire coast of Connemara to the boundary of county Mayo, there is a succession of harbours for vessels of the largest class, unequalled perhaps on any similar extent of coast in Europe. These harbours are at Galway, Costello Bay, Casheen Bay, Greatman's Bay, Kilkeran Bay, Birtmbuy Bay, Roundstone Harbour, Mannin Bay, Clifden Bay, Clrggan Roadstead, Ballynakill Harbour, and Killary Harbour. Some of these harbours have piers or jetties. On the whole there is no part of this district more than 4 miles from existing means of navigation. The harbours fit for vessels of any burden are upwards of twenty in number. There are twenty five navigable lakes of a mile or more in length, and hundreds of smaller size; Lough Corrib and Lough Mask alone have upwards of 70 miles of navigable coast; and all these waters abound with fish. The seashore affords a constant supply of red and black seaweed, which can be used either as manure or in the manufacture of kelp. Banks of calcareous sand and beds of limestone are of frequent occurrence, and there is an inexhaustible supply of peat fuel and of water power.

The rivers of Galway, being either feeders of the Suck and Shannon, or descending by short courses from the western district to the sea, are in general small. The chief among them are the rivers of Clare-Galway and of Shrule. There are several periodical or intermittent lakes and streams, owing to the porous nature of the limestone rock which forms the substratum.

The climate is mild, and snow rarely lies in the western district. Cattle in this part of the country are never housed. The summers are wet, and the coast is exposed to very heavy storms from the Atlantic. In respect to geology, the eastern part of the county, with the exception of a portion of the sandstone and clay-slate formation of the Slieve Boughta range, which it includes, and of the range of the Slievo Dert hills, on the borders of Roscommon, is understood to consist almost wholly of the same flotz limestone tract which extends over the central plain of Ireland. The district of Lough Corrib and Lough Mask is mostly of primitive formation. The mountains of the primitive district are highly metalliferous. Copper, lead, iron, and manganese are met with, but limestone and marble are the chief minerals. In Connemara there is abundance of most beautiful green variegated marble, called Serpentine; the black, near Oughterard, is also very fine, and is exported to the London and other markets. In this district also a sulphur mine has been for some time extensively worked.

The richest soil in this county occurs in a tract extending from Gort through Loughrea to Portumna, Eyre Court, and Ballinasloe. The wheat produced in the southern portion of this tract is of a superior quality, and the numerous demesne lands occurring throughout it are among the best pastures in Ireland. The remainder of the eastern district is chiefly an oat and barley growing country. On the lighter soils great numbers of sheep are fed. A good deal of bog land has been reclaimed, on which the crops are oats and potatoes; but agriculture is backward. The land is better adapted for grazing than for tillage, and great attention is now paid to the rearing of cattle. A much larger number is kept than formerly, and they are generally well managed.

The fisheries off the coast yield a very considerable supply, although by no means as productive as they might be made. Besides the herring fishery, there is an excellent take of cod, ling, whiting, and turbot, from December to March; and of gurnet, mackerel, bream, and pollock, from May to August, together with a copious supply of oysters, lobsters, and crabs. The sun fish deep sea fishery is peculiar to this coast. The manufactures of this county are a few coarse friezes, linens, and hosiery.

Divisions.—Galway is divided into eighteen baronies, of which the Isles of Arran form one. It is in the Connaught circuit, and the assizes are held at the town of Galway. According to the Reform and Redistribution Acts of 1884–85 one member is returned for the borough of Galway, and one each for the four divisions of the county.

Civil History.—The Anglo-Norman family of De Burgho and their followers possessed the chief power in this part of Ireland till the middle of the fourteenth century, from which time the county was in a very lawless state till the reign of Elizabeth. English law was again introduced by Sir Henry Sidney in 1585, but the Irish mode of life continued to prevail until after the rebellion of 1641 and the war of the Revolution of 1688, both of which events affected the property and population of this county to a great extent. Galway is very rich in antiquities.

GALWAY, a county of a town, seaport, and the capital of the above county, is situated on the north side of Galway Bay, 126½ miles west from Dublin by the Midland Great Western Railway. The population in 1881 was 19,171. The town, which is much frequented during the summer for sea-bathing, stands on both sides of the river which flows from Lough Corrib, which is 20 miles long, into Galway Bay. The river is crossed by two bridges. The greater part of the town is ancient, and the streets and houses partake of the appearance of a Spanish town; but of late years several new streets, with many good houses, have been erected. One of the ancient houses, marked with a skull and crossbones, has a curious history attached to it. The son of one of the mayors, James Lynch Fitzstephen, having committed murder, was hanged by his father from one of the windows of this, his own house, to prevent a rescue. This occurred in 1493. In former times Galway had a rather extensive commercial intercourse with Spain, which accounts for the Moorish character of some of its architecture. The principal buildings are—the collegiate and parish church of St. Nicholas, a fine old building; several Roman Catholic chapels, monasteries, and nunneries; Congregational, Methodist, and Presbyterian meeting-houses; the Queen's College, model national school, a very superior hotel adjoining the railway station, a county court-house, town court-house, gaol, county infirmary, fever hospital, union workhouse, and barracks. There are many flour and other mills driven by water-power, and the cutting and polishing of native black marble has become a business of some importance. Wheat, oats, flour, kelp, wool, and large quantities of native black marble are exported. Timber, iron, slates, wines, &c., are imported, and a considerable retail trade is carried on in the town. A wet dock, comprising 9 acres and admitting vessels drawing 14 feet of water, has been formed on the south side of the town. On the west side of the river is the extensive suburb of

Claddagh, which is exclusively inhabited by a race of fishermen, who are marked by many peculiar and distinctive habits. The assizes for the county of Galway are held in the town, which is itself governed by a high sheriff, recorder, mayor, and other officers, and a board of twenty-one commissioners, elected triennially. Galway is the see of a Roman Catholic bishop. It returns two members to the House of Commons, the constituency being fully 1000. The number of vessels registered as belonging to the port of Galway in 1884 was 20 (800 tons). The entries and clearances each average 200 (35,000 tons) per annum. The customs revenue in 1883 was £8866. The Bay of Galway is an immense sheet of water protected from the swell of the ocean by the natural breakwater of the Arran Isles. More than one attempt has been made to constitute the port a packet-station, it being the nearest to America in the United Kingdom, but owing to a variety of unfortunate circumstances the scheme could not be carried into practical effect.

Galway is thought to be the *Nagnata* of Ptolemy. It was surrounded with walls in 1270, and shortly after became the residence of Norman, Saxon, or Welsh settlers. The town attained to great commercial prosperity and obtained a charter from Richard II. In 1641 the Parliamentarians drove out most of the inhabitants, and many English adventurers and soldiers were settled there.

GAL'WAY BAY, a large inlet of the Atlantic, with a length east to west of 30 miles, and a breadth of 10 miles. The entrance is protected by the lofty cliffs of the Isles of Arran. It is the finest bay in Ireland, and offers unusual facilities for an Atlantic trade, being only 1636 miles distant from St. John's, Newfoundland, and 2700 from New York. It is the legendary Lough Lurgan, a fresh-water lake, into which the Atlantic is said to have broken owing to the subsidence of the land.

GAMA, VASCO DA, the first European navigator who found his way to India by doubling the Cape of Good Hope, was born at the small seaport town of Sines in Portugal, but the date is not exactly known. He was in the household of Manoel, king of Portugal, and having devoted himself to navigation and discovery, was appointed to the command of an expedition which was to seek its way to the Indian Ocean by sailing round the southern extremity of Africa. The notion of this passage was not a new one, and when taken up by the Portuguese king its practicability had been pretty well established. Bartholomew Diaz had already, in 1487, doubled the Cape in a storm, and discovered 300 leagues of coast; he recognized the Cape on his return. Vasco da Gama sailed from Lisbon on the 8th of July, 1497, five years after the discovery of the New World by Columbus. His squadron consisted only of three small ships with sixty men. Dreadful tempests were encountered, and a mutiny broke out to induce Gama to return. He allayed it, however, and on the 19th of November doubled the Cape and turned along the eastern shore. At the African town of Melinda he found Christian merchants from India and a pilot from Gujerat. Under this pilot's guidance Vasco da Gama reached the coast of Malabar in twenty-three days, and anchored before Calicut, a place of considerable manufacture and foreign trade, then chiefly in the hands of the Moors. He was at first very favourably received by the zamarin or king of Calicut, but he had unluckily brought no suitable presents, and the Moors were jealous of the new-comers, and when wishing to leave he had to fight his way out of the harbour. On his return he again anchored at Melinda, and took on board an ambassador from the Muhammedan prince of that place. He arrived at Lisbon in September, 1499. The sounding title of Admiral of the Indian, Persian, and Arabian Seas was conferred on him. This voyage of Gama is a great epoch in commercial history; it showed the nations of the West the sea-road to the remote East; it diverted the trade of the East from the Persian Gulf, the Red Sea, Asia Minor, Egypt, and Italy, the routes in which it had run for 1400 years; and it led ultimately to the establishment in India of a vast empire of European merchants. The effect it had upon Italy was most disadvantageous; and though there were other causes at work, the decline of the great trading republics of Venice and Genoa may be traced to the discovery of the passage to India by the Cape of Good Hope.

A second expedition to India, under the command of Pedro Alvarez Cabral, led to the accidental discovery of Brazil, whence, however, the little fleet reached India, and Cabral established a factory at Calicut. The Portuguese, however, left by Cabral were all murdered. In consequence a third expedition was fitted out of twenty ships, of which the command was intrusted to Gama. On his way he settled factories at Sofala and Mozambique, punished the towns that had before been unfriendly to him, and after various other adventures reached Calicut, where he seized all the ships in the port. He then demanded full and sanguinary satisfaction for the murder of the Portuguese, and would listen to no other terms. After three days he hung fifty Malabar sailors he had taken in the port, then cannonaded and nearly destroyed the town. He made a treaty with the neighbouring state of Cochin, by which they agreed to assist each other against Calicut, and then, having left five ships to protect the factory, he returned to Lisbon in December, 1503, and was created Count of Videqueray. The Indian conquests were prosecuted by Albuquerque and others. In 1524 Gama was appointed viceroy of Portuguese India, and was the first who received that high title. He died, however, soon after his arrival at Cochin, in December, 1525. In 1538, by order of John III., his remains were removed to Portugal.

GAMA'LIEL I., or the Elder, is mentioned in Acts v. and xxii., and also in the Talmud, where he appears as a teacher of the law and a member of the Sanhedrim; but neither of these writings gives any account of his birth or death. During his life the laws and ordinances imposed by the Sanhedrim are distinguished by their humanity and liberality. St. Paul was a pupil of Gamaliel's, whose memory has always been held in great honour. His name is in the Roman Catholic calendar of saints, and his day is celebrated on the 3rd of August.

GAMA'SUS. See ACARIDEA.

GAM'BA, an organ stop, in which the tone of the viol da gamba is sought to be imitated. It has open cylindrical pipes, cut up at the mouth; and gives a somewhat thin stringy tone, in some good examples very unlike an ordinary "flute" pipe. This character makes it extremely useful as an accompanying stop, and probably very few organs, however small, are without it.

GAM'BA, VIOL DA, a large tenor violin or *viola*, called *da gamba* (of the leg), to distinguish it from the viola proper, which was held on the arm (*da braccio*). The gamba was larger than the tenor viola, and was the favourite instrument for a long time, serving also as bass to the "chest of viols." It is now quite superseded by the violoncello, which began to supplant it about 1750. It differed from the latter (which is of almost pure violin type) in several respects. The gamba had a flat back like a contrabasso, or like a guitar; the finger-board was usually fretted, also like a guitar; and it had six strings tuned in two sets of Fourths, thus—

A seventh string, the top G, was afterwards added. It will be observed that the strings of the gamba go to within one note of the bass C of the violoncello, and extend one Fourth (or two Fourths) upwards beyond its *a* string.

Its tone was thinner than that of the violoncello, and fell off greatly towards the bass. Sometimes extra strings were attached to the back of the neck of the viol da gamba; and these, being tuned to the common chord of the key in use, served as a ready pizzicato accompaniment to the melody, which was produced from the proper strings of the instrument by the bow.

GAMBET'TA, LÉON MICHEL, a politician of republican principles, who, from the fall of the French Empire in 1870 until his death in 1882, exercised the chief influence over the destinies of the French nation. He was born at Cahors on 3rd April, 1838, where his father kept a small shop. His grandfather, Léon Gambetta, was a Genoese emigrant, who settled in France at the beginning of the present century. Being sent to the Catholic seminary in the hope that the abilities he already showed might ultimately raise him to high position in the Romish priesthood, Gambetta was remarkable for his religious earnestness, and when twelve years old he wrote an ode dedicated "to his patron, St. Leo, and to all the popes called Leo." This composition was printed in the Catholic journal of the diocese. He was then sent to the local university, in which nearly a couple of centuries earlier Fénélon had been a student. In his sixteenth year he had the misfortune to lose the sight of one of his eyes, and being forbidden to read the evenings were spent by his aunt reading to him the parliamentary debates published in the *Constitutionnel* for 1840–42. The speeches of M. Thiers made him a politician, and inspired him with the ambition to become an orator. From Cahors Gambetta went to Paris to study law; and he quickly drew the attention of the imperial police upon himself by acting as ringleader in those demonstrations which the students of the Latin Quarter were accustomed to make in times of public excitement.

In 1859 he was called to the French bar, and became a speaker at private meetings of the opponents of the empire at various cafés. He did not, however, neglect his profession, but served as secretary to M. Adolphe Crémieux, who had a large practice at the French bar. He had served before this for a few weeks under M. Charles Lachaud, the popular barrister in criminal cases; but he was an imperialist, and Gambetta abruptly left him.

A daring and bitter attack which he made on the empire in a press case in 1868 first made him famous, and he at once received the position of a leader among the republicans. In the elections of 1869 he was chosen both for Belleville and for Marseilles, on irreconcilable principles animated by an unquenchable hatred of the empire. He chose to sit for Belleville. While in the Chamber he delivered a speech against the Olivier ministry, defying the government and proclaiming that the reforms they suggested would be simply used as a bridge to carry France over to another form of government.

After the first defeats of the imperial troops in the war with Germany, Gambetta's influence greatly increased. He would have preferred the deposition of the Napoleonic dynasty by legal means, but the mob of Paris was too impatient, and installed a government of its own at the Hotel de Ville, which took the name of the Government of the National Defence. In this Gambetta accepted the post of minister of the interior. The German siege of Paris afforded him a great opportunity, of which he did not fail to avail himself. He had to leave Paris in a balloon, and in going over the German lines nearly met with misadventure through the balloon sinking till it came within range of some marksmen's rifles. But he reached Tours in safety, and set to work at once, with marvellous activity, to levy and equip fresh armies to resist the invasion. He was ably seconded by M. de Freycinet, and between them all was done that was humanly possible; but from the first their task was one of formidable difficulty, and all chances of repelling the Germans from French soil vanished after the capitulation of Bazaine at Metz. The political condition of France during these campaigns was such as to invest Gambetta with the powers of consul and dictator. Though it was clear that further resistance was useless, Gambetta, rather than take part in the national surrender, resigned. He was by that time nearly worn out, and had to go to St. Sebastian to recruit his health, but he was returned by nine constituencies at the armistice elections.

From this time the power of the sincere republicans was centred in him, and he directed his policy to drawing together their scattered forces and to obtaining the recognition of the republic as the legal government of France. This was accomplished when the republic was proclaimed by the Chamber in 1875. The struggle between the republicans and the reactionaries at last ended in the resignation of Marshal MacMahon in 1879 and the succession of President Grévy, when Gambetta became president of the Chamber of Deputies. After the general election of 1881 he found that he could no longer refuse office. He was appointed in November, and resigned in January, 1882, having been refused a revision of the constitution, which should include *scrutin de liste*, or the voting by whole departments, as a fundamental principle of elections. It is probable that he did not entirely regret this, as it would have left him in a better position for the election for the presidency in 1885. He was not, however, destined to live to that time, for he expired somewhat suddenly on 31st December, 1882, at the age of forty-four. Gambetta fairly earned a position among the greatest orators of his time, and whatever may be thought of his political opinions, his patriotism was unquestionable.

GAM'BIA, a river in Africa, which rises in the mountains of the interior, about 11° 30′ N. lat., and 11° W. lon. Considerably more than one-half of its course lies W.N.W. through the mountain region. Where it begins to emerge from the mountains and to enter the hilly country, which separates them from the plain along the shores of the ocean, it receives on the right a considerable branch—the Nerico —which comes down from Bondou with a south-western course. Soon afterwards it turns due west, and continues in this direction to its entrance into the ocean between 13° and 14° N. lat. The tide ascends nearly as far up as Barraconda, near which there is a rapid which impedes the navigation; from this point to its mouth the course of the river is well known; it mostly runs through a flat country, which, however, for some distance is inclosed by hills and rising-grounds; these heights, however, sink lower and lower, and disappear entirely at Kaye, about 120 miles from the mouth of the river. The flat countries along its banks are annually inundated, and are distinguished by their vigorous vegetation. The Casamanzo, which enters the ocean about a degree further south, is a branch of the Gambia; at its mouth the Gambia is 4 miles across, but immediately within this its width is doubled.

GAM'BIA, a British colony in Western Africa, consisting of the island of St. Mary, with the town of BATHURST (13° 24′ N. lat., 16° 36′ W. lon.), at the mouth of the river, and several forts on its banks, along which British influence extends to beyond M'Carthy Island, in lat. 13° 28′ N. and lon. 15° 32′ W. The area of the British settlement is about 20 square miles, and the population at the census of 1881 was 14,150, of whom only 105 were whites. The climate is very deleterious. The total amount of public revenue and expenditure is each about £20,000 per annum. There are twenty schools, with 2000 scholars. The total value of the imports is about £100,000 per annum, and of the exports £150,000, mostly from and to Great Britain, France, and the United States. The principal articles imported are cotton goods, tobacco, rum, rice, guns, and gunpowder; the exports being chiefly ground nuts, hides, clean wax, gum, tortoise-shell, cotton, ivory, gold dust,

palm-oil, horns, and timber. It is a dependency of Sierra Leone, and the natives are superior in intelligence and civilization to the other intertropical tribes of Africa. In 1870 it was proposed to transfer the settlement to the flourishing French colony of Senegal, it being of no use to Great Britain; but the scheme was opposed in Parliament, and ultimately abandoned.

GAM'BIER EXTRACT. See CATECHU.

GAM'BIER ISLANDS, a group of five large islands in the Pacific Ocean, 23° 15′ S. lat., 134° 45′ W. lon. The French exercise a protectorate over the islands, which are important as being the only place between Chili and Tahiti where good water is procurable.

GAMBLING or **GAMING** is an amusement, or we might properly call it a vice, which has always been common in all countries and among all classes, but more particularly among those who are of idle habits. In England, before the passing of the 8 & 9 Vict. c. 109, wagers or bets, but not debts arising from games of chance, were in common law viewed as legal contracts, and the winner of a wager could enforce his claim in a court of law. The exceptions to this rule were, when the wager was an incitement to a breach of the peace or to immorality; when it affected the feelings or interests of third persons, or exposed them to ridicule or inconvenience; or when it was against sound policy.

By the 8 & 9 Vict. c. 109 it was enacted "That all contracts or agreements, whether by parole or in writing, by way of gaming or wagering, shall be null and void; and that no suit shall be brought or maintained in any court of law or equity for recovering any sum of money or valuable thing alleged to be won upon any wager, or which shall have been deposited in the hands of any person to abide the event on which any wager shall have been made; provided always that this enactment shall not be deemed to apply to any subscription or contribution or agreement to subscribe or contribute for or toward any plate, prize, or sum of money to be awarded to the winner or winners of any lawful game, sport, pastime, or exercise." Under the same Act cheating at play is to be punished as obtaining money under false pretences.

No sooner, however, were contracts as to horse-racing legalized than a great number of petty gaming houses sprung up under the name of "betting offices," and the 16 & 17 Vict. c. 119 was passed expressly for suppressing these places. The 37 Vict. c. 15 was passed in 1874, and is to be construed as one with the 16 & 17 Vict. c. 119, and was extended to Scotland. It is now enacted that where any letter, circular, telegram, placard, handbill, card, or advertisement is sent, exhibited, or published, whereby it is made to appear that any person either in the United Kingdom or elsewhere will, on application, give information or advice for the purpose of, or with respect to, any bet or wager or any event or contingency as is mentioned in the principal Act, or will make on behalf of any other person any such bet or wager as is mentioned in the principal Act, or with intent to induce any person to apply to any house, office, room, or place, or to any person with the view of obtaining information or advice for the purpose of any such bet or wager, or with respect to any such event or contingency as is mentioned in the principal Act, or inviting any person to make or take any share in or in connection with any such bet or wager, every person offending shall be subject to the penalties provided in the seventh section of the principal Act.

By the Vagrant Act of 1873 persons playing games of chance, or betting in public places, can be dealt with as rogues and vagabonds. All gaming-houses are regarded as nuisances at common law, and those who keep them are liable at common law (independently of statutory provisions) to be indicted and punished by fine and imprisonment at discretion.

In Scotland wagers or bets have always been regarded as *sponsiones ludicræ*, and no action can be maintained for sums won in that manner. This, however, does not prevent the courts from dealing with questions as to the awarding of prizes in associations formed for laudable purposes, such as agricultural shows. It has been held that speculative transactions in stocks are not gaming or wagering.

GAMBOGE or **CAMBOGE** is a gum-resin introduced into Europe about the beginning of the seventeenth century. Its source was for long doubtful, but of late years it has been ascertained that it is chiefly derived from *Garcinia Morella*, a tree belonging to the order GUTTIFERÆ, and a near ally of the famous MANGOSTEEN. The small yellow flowers are either male or female, with four sepals and four petals. There are numerous stamens, or an ovary surrounded by a few barren stamens, ripening into a four-seeded fruit. This tree is a native of Cambodia and parts of Siam and Cochin-China. Other species of the genus inhabit India and the Malay Archipelago.

The yellow juice which, in a hardened state, forms gamboge, flows in vessels in the bast-layers. It is obtained by making cuts in the bark, and catching the juice in hollow joints of the bamboo. This forms the "pipe gamboge" of commerce. "Cake gamboge" is of an inferior quality.

Gamboge is almost entirely soluble in alcohol, and is not precipitated from solution by the addition of water. With water it forms an emulsion, in which the resin is kept suspended by the gum. It is soluble in the alkalies. The resin may be considered its active principle. It is remarkable that a substance possessed of such slight sensible qualities, having no smell and scarcely any taste, should be so powerful in its action on the human frame. It is a drastic purgative, and in combination with alkalies forms a most powerful hydragogue cathartic, occasioning numerous copious watery motions. In an overdose it causes excessive purging, sometimes vomiting; and if taken in large quantity, it produces inflammation of the intestines, mortification, and death.

The diseases in which it is most useful are ascites, or dropsical accumulations in the cavity of the abdomen, especially if accompanied with obstructions in the liver or other abdominal viscera. It has also been employed against the tapeworm and obstinate or habitual constipation, but it should never be taken except under the order of a medical attendant. It is much more used as a pigment and as a colouring matter for varnishes.

GAME LAWS. Game has been a subject of legislation from the Conquest to the present time. It is declared to include hares, pheasants, partridges, grouse, heath or moor game, black game, and bustards. Snipe, quail, landrail, woodcock, and conies are not game.

Any person who purchases a certificate or license may kill game on his own land or upon the land of any other person with his permission. This alteration was effected by 2 Wm. IV. c. 32, before which time a person was required to be possessed of a qualification by estate or birth to entitle him to kill game. By 22 & 23 Car. II. c. 25 the qualification was limited to persons who had an estate of inheritance of £100 per annum or an estate for the term of life or ninety-nine years, or upwards of £150 annual value. On this Blackstone remarks, there was "fifty times the property required to enable a man to kill a partridge as to vote for a knight of the shire." Qualifications were also of a personal nature, as being the son and heir apparent of an esquire. Persons who had not these qualifications were not allowed to have or keep game dogs.

Certificates were first required to be taken out by persons qualified to kill game by the Act 25 Geo. III. c. 50. The certificate itself now gives a qualification under the 23 & 24 Vict. c. 90; it costs £3, must be taken out annually, and expires in April; or one may

be taken for the months between the 5th April and the 31st October in the same year, for £2. Uncertificated persons who kill or take any game, or who use any dog, gun, &c., for the purpose of searching for or killing or taking game, are liable, on conviction before two justices, to a penalty not exceeding £5 for each offence, with additional penalties under the Certificate Act. The law is very severe against persons not authorized who take and destroy game by night. Day-time is to be deemed from one hour before sunrise to one hour after sunset. The punishment for night-poaching is still more severe when three or more persons enter any land for the purpose of taking or destroying game or rabbits, armed with a gun, bludgeon, or other offensive weapon.

The 25 & 26 Vict. c. 114 gives power to constables to search, without warrant, in any highway, street, or public place, any person whom they may suspect of coming from lands where they may have been in unlawful pursuit of game.

Many landowners formerly took means to insure the preservation of game, which none but tenants in a state of dependence would submit to. The tenant was not allowed to use his best skill in the application of his capital to the land, but was interfered with on account of the game. This game devoured the produce of the land, was fattened at the tenant's expense (compensation for the destructiveness of game being generally futile and deceptive), and the landlord pocketed the money which the game thus fed produced in the market. The effect would have been far less injurious had the landlord turned a certain proportion of his oxen and sheep to feed with those which belonged to his tenants. There were instances where the landlord let the game on the tenant's land to a third person, and thus got two rents, one rent for the land and another for the game after it had been fed by the farmer. This system has to a great extent been rendered a thing of the past. The principle of the Ground Game Act, passed in 1880, for the better protection of occupiers of land against injury to their crops, was to give the occupier an inalienable right to kill all the ground game on his occupation, concurrently with any other person who may be entitled to kill and take ground game on the same land; and should he make any contract to the contrary, it cannot be enforced by law.

In Scotland game laws existed from a very remote period, and even before the Union proceeded on much the same lines as in England. It has always been held in Scotland that the property in game is acquired by occupation only, and hence that game becomes the property of the person who first kills or apprehends it; and the game laws, though enforced by penalties, do not deprive such person of his property in the game, unless when this is expressly made part of the penalty.

In 1878 an Act came into operation in Scotland, the 40 and 41 Vict. c. 28, which amended several previous Acts, and by which a lessee became entitled to compensation for damage done to his crops in each year by game to which the lessor might have reserved or retained the sole right, in excess of any such sum as might have been set forth in the lease as the amount of annual damage. The lessee may kill hares without a game certificate.

In France, before the first Revolution, there were exceedingly severe edicts for preserving game, but the Constituent Assembly abolished this exclusive "droit de la chasse." See also our own FOREST LAWS.

Until the passing of the Act 1 & 2 Wm. IV. c. 32, no person was allowed to sell game. A dealer in game must now obtain an annual license from the justices, who hold a special session in July for the purpose of granting such licenses. Innkeepers, victuallers, retail beer-sellers, guards, coachmen, carriers or higglers, or persons in the employ of any of these classes of persons, are prohibited from dealing in game. Licensed dealers who buy game of any person not authorized to sell it are liable to a penalty of £5. A person not being licensed, who buys game from an unlicensed person, subjects himself to a penalty not exceeding £5 for each head of game, with costs.

GAMES. Among the ancient Greeks and Romans public games and combats appear to have formed a most important part of the national and religious festivals. The four principal games publicly solemnized in Greece, and frequently mentioned by historians and poets, were the ISTHMIAN, the OLYMPIC, the PYTHIAN, and the NEMEAN. Among the early Romans the public games were of different kinds at different eras of the republic. Perhaps at first, as in Greece, a victor's crown at the games was a prize honourably to be sought after by the best of the young citizens; but almost before the end of the kingly period the games had become exhibitions before spectators, not contests in the presence of competitors. Trained boxers and riders delighted the crowd, but no well-bred person dreamed of entering the lists. It was among the bitterest reproaches against Nero that he lowered himself to compete in the games as a musician and actor, and against Commodus that he fought in the arena as a gladiator.

The great Roman games, or "Great Games" (*Ludi Romani*, or *Maximi*), were of very ancient origin, older

Ancient Foot race.

than the republic certainly, and were held in September in the Circus Maximus. Contests took place in music, dancing, chariot racing, fighting, &c., on the Greek model, with the grave difference noted above. An extra day's games was added on the establishment of the republic, and again twice after the conclusion of the great revolutions of B.C. 494 and 367; so that eventually the festival lasted four days, and the city was at the expense up to 200,000 sesterces, about £2000 of our money. The ædiles, of course, sought to curry favour by handsomely contributing towards the additional expenses. By about 350 B.C. rude attempts at drama were added, and soon the theatrical part of the games was second only to the chariot race in causing eager delight. Many events contributed in filling Rome with a rabble of idlers who lived upon their voting power; and by about 200 B.C. this body, one of the vilest and most useless collections of civilized men ever organized, had come to exist for the most part on the public corn and be amused at the public expense. By the time of the empire the cry actually arose, "Bread for nothing and games for ever!" But long before this the games had been increased.

in splendour and number to keep in good humour this terrible mob of so-called citizens, which threatened at every moment to throw the state into the greatest danger. In 220 B.C. Flaminius built a second circus, and appointed a second series of November games, the Plebeian Games (*Ludi Plebei*). Then came the institution of the games of Ceres in April (*Ludi Cereales*); then a fourth series held in June, the *Apollinares*, in honour of Apollo, in B.C. 212; then a fifth series held in early April, the *Megalenses*, in honour of the Phrygian Demeter, or "great mother," to celebrate the commencement of her worship, in B.C. 204. Lastly, a sixth series at the end of April, dedicated to Flora (*Ludi Floreales*), was added B.C. 178. These last games were openly defrayed by successful candidates for office; they formed, in fact, a strong property qualification. It is well known that the great Cæsar was hopelessly in debt through the festivals celebrating his elections, and his case was only a typical one. Each ædile or consul vied with his predecessor in splendour and extravagance. Each show, with gladiators on the usual scale, cost 720,000 sesterces (about £7200); and that was only one part of the games. The provinces were heavily taxed to help towards this costly magnificence. The great games had now developed into a six-days' festival, and extraordinary games were not unfrequent if any great noble wished to gain the ear of the venal mob. The baiting of wild beasts in the arena was introduced to spur on the jaded appetites of the pampered crowd. Men fought for the first time to the death to amuse their fellow-men in B.C. 264. Lions and panthers were brought for the first time from foreign lands at great cost and danger, to astonish the frequenters of the circus, in B.C. 186. Rome had indeed wandered far from the noble sports of the free men at Olympus or at Corinth. These new and beautiful beasts, with their strange and added danger, delighted the baser tastes of the Romans. Sulla caused no less than 100 lions to fight in the arena at his prætorship in B.C. 93. Elephants first appeared in B.C. 99. The public games at Rome at about the commencement of our era covered altogether the space of sixty-two days, over one-sixth of the year; and fully half as much again was provided on private occasions of rejoicing, as elections to office, funerals, and the like. Marcus Æmilius Lepidus, in his will (B.C. 152), commands his children only to spend £10,200 on his funeral games, as he wisely proclaims true honour to consist not in empty pomp, but in the remembrance of merit. For four centuries did this brutal massacre of beasts, and this slaughter of gladiators by their hundreds every year, continue, until Honorius, about A.D. 400, finally abolished the latter. In the form of bull-fights the former still continues to disgrace the descendants of the Roman Empire in Spain and in Southern France. It seems hardly credible that in 1884 the entire municipality of Nimes, backed by 5000 citizens, were found to protest against a minister (Waldeck Rousseau) stopping their bull-fights. In Louis Philippe's time a similar attempt produced such riots that the soldiers were called out. Of the painful martyrdoms of the early Christians in the amphitheatre, where they were thrown to the lions in the first centuries of our era, before Christianity had yet become the imperial religion, this is not the place to speak. Although these things are to us most appalling, they were not necessary (nor even frequent) features, we may thankfully say, of these degrading games of the masters of the ancient world.

Under the emperors there were many places called Gymnasia, where the Romans were accustomed to exercise their bodies by various games before bathing. These exercises consisted chiefly of throwing the javelin, the ball, or the quoit, leaping, running, riding, &c.

GAM'MARUS is a genus of sessile-eyed crustaceans (EDRIOPHTHALMA), belonging to the order Amphipoda. One species, the fresh-water shrimp (*Gammarus pulex*), is very abundant in Britain. It always swims near the bottom on its side, and its progression is principally performed by the rapid jerks of the appendages of the tail. The animal is carnivorous, and feeds principally on dead fishes, and often on the carcases of its own species. The female keeps her eggs till they are hatched, and the young for some time seek shelter under her abdomen and the lateral appendages of her body. There are some marine species.

GAMOPET'ALÆ, in botany, is a division of Dicotyledons. This division is also known as Monopetalæ and Corollifloræ. The distinguishing feature is that the petals, which are separate in the division Polypetalæ, are here united, so that the corolla is in one piece. The calyx is distinct. The corolla springs directly from the receptacle. The stamens are generally attached to the corolla (*epipetalous*). The carpels are usually united together (*syncarpous*).

There are many plants included in this division which have polypetalous or apetalous flowers, but otherwise agree with gamopetalous orders. For a classification of these orders, see the article BOTANY.

GAM'UT, an obsolete expression for the scale. The lowest note of music in Guido's time was *Gamma* (the Greek for G); and in the hard hexachord this note was the keynote or *ut*, hence *Gamma ut*, or Gamut, came to mean the principal scale (hexachord), and hence scale in general. [See HEXACHORD.] Occasionally in our older writers gamut is used for the key of G, as "Blow in Gamut" for Blow's service in G. The French still use the modified form of the word *gamme* as their expression for scale.

GAN'GES, the great river of Northern India, formed by the drainage of the southern ranges of the Himalayas. This magnificent stream, which in its lower course supplies the river system of Bengal, rises in the Garhwal State in 30° 56″ N. lat., and 79° 6″ E. lon., and falls into the Bay of Bengal after a course of 1557 miles. It issues, under the name of the Bhagirathi, from an ice-cave at the foot of a Himalayan snow-bed above Gangotri, 13,800 feet above the level of the sea. During its earlier passage through the southern spurs of the Himalayas it receives the Jhanari from the north-west, and subsequently the Alaknanda, after which the united stream takes the name of the Ganges. Deo Prayag, their point of junction, is a celebrated place of pilgrimage, as is also Gangotri, the source of the parent stream. At Sukhi it pierces through the Himalayas and turns south-west to Hardwar, also a place of great sanctity. Thence it proceeds by a tortuous course through the districts of Dehra Dun, Saharanpur, Muzaffarnagar, Bulandshar, and Farrukhabad, in which last district it receives the Ramganga. At Allahabad the type of the river changes. Heretofore the Ganges has been little more than a series of shoals, pools, and rapids—except, of course, during the melting of the snows and the rainy season. At Allahabad, however, 668 miles from its source, it receives the Jumna, a mighty confluent, which also takes its rise in the Himalayas to the west of the sources of the Ganges. The combined river winds eastward by south-east through the North-western Provinces, receiving the Gumti and the Gogra. The point of junction of each of these streams has more or less claim to sanctity. But the tongue of land at Allahabad, where the Jumna and the Ganges join, is the true Prayag, *the* place of pilgrimage, to which hundreds of thousands of devout Hindus repair to wash away their sins in the sacred river.

Of all the great rivers on the surface of the globe, none can compare in sanctity with the Ganges, or Mother Ganga, as she is affectionately called by devout Hindus. From her source in the Himalayas to her mouth in the Bay of Bengal, every foot of her course is holy ground; and many of the other sacred rivers of India borrow their sanctity from a supposed underground connection with her waters.

It is interesting to observe that this superstition is not to be found in the earliest books of Sanskrit literature, composed at a time when the primitive Aryan race had not yet penetrated into the great plain of Eastern Hindustan. The legend of the Ganges first appears in the two epic poems of the Mahabharata and Ramayana, and affords abundant scope for the mytho-poetic faculty subsequently displayed in the voluminous literature of the Puranas.

After the lapse of twenty centuries, and the rise and fall of rival religions, veneration for the Ganges still figures as a chief article in the creed of modern Hinduism. To bathe in the Ganges, especially at the great stated festivals, will wash away the stain of sin; and those who have thus purified themselves carry back bottles of the sacred water to their less fortunate relations. To die and be burned on the river bank is a passport to eternal bliss. Even to exclaim "Ganga, Ganga," at the distance of 100 leagues, will atone for the sins committed during three previous lives.

The river thus reverenced by the Hindus deserves their homage, by reason of its exceptional utility for agriculture and navigation. None of the other rivers of India approaches the Ganges in beneficence. The Brahmaputra and the Indus may have longer streams, as measured by the geographer, but the upper courses of both lie hidden within the recesses of the Himalayas. Not one of the great rivers of Central or Southern India is navigable in the proper sense of the term. The Ganges begins to distribute fertility as soon as it reaches the plains within 200 miles of its sources; and at the same point it becomes in some sort navigable. Thenceforward it rolls majestically down to the sea in a bountiful stream, which never becomes a merely destructive torrent in the rains, and never dwindles away in the hottest summer. If somewhat diminished by irrigation, its volume is forthwith restored by numerous great tributaries; and the wide area of its river basin receives annually a sufficient rainfall to maintain the supply in every part. Embankments are in few places required to restrain its inundations, for the alluvial silt which it carries over its banks year by year affords to the fields a top-dressing of inexhaustible fertility. If one crop be drowned by the flood, the cultivator calculates that his second crop will abundantly requite him.

Shortly after passing the holy city of Benares the Ganges enters Behar, and after receiving an important tributary, the Son, from the south, passes Patna, and obtains another accession to its volume from the Gandak, which rises in Nepal. Further to the east it receives the Kusi, and then, skirting the Rajmahal Hills, turns sharply to the southward, passing near the site of the ruined city of Gaur. By this time it has approached to within 240 miles of the sea. About 20 miles further on it begins to branch out over the level country, and this spot marks the commencement of the Delta, 220 miles in a straight line, or nearly 300 by the windings of the river, from the Bay of Bengal. The main channel takes the name of the Padma or Padda, and proceeds in a south-easterly direction past Pabna to Goalanda, where it is joined by the Jamuna, or main stream of the Brahmaputra. The vast confluence of waters rushes towards the sea, receiving further additions from the hill country on the east, and forming a broad estuary known under the name of the Meghna, which enters the Bay of Bengal near Noakhali. This estuary, however, is only the largest and the most easterly of a great number of mouths or channels. The most westerly is the Hoogly, which receives the waters of the three westernmost distributary channels that start from the parent Ganges in or near Murshidabad district. Between the Hoogly on the west and the Meghna on the east lies the Delta. The upper angle of it consists of rich and fertile districts, such as Murshidabad, Nadiya, Jessur, and the twenty-four pergunnahs. But towards its southern base, resting on the sea, the country sinks into a series of great swamps, intercepted by a network of innumerable channels. This wild waste is known as the Sundarbans, from the sundri tree, which grows in abundance in the sea-board tracts. The most important channel for navigation is the Hoogly, on which stands Calcutta, about 80 miles from its mouth. Above this city the navigation is almost entirely conducted by native craft, the modern facilities for traffic by rail, and the increasing shoals in the river, having put an end to the previous steamer communication which plied until about 1860 to as high up as Allahabad. In the upper portion of its course, in the North-western Provinces, timber and bamboos form the bulk of the river trade, and in the lower part, bordering on Bengal, stone, grain, and cotton. Below Calcutta important boat routes through the Delta connect the Hoogly with the eastern branches of the river, both for native craft and steamers. The Ganges is essentially a river of great cities—Calcutta, Monghir, Patna, and Benares lie on its course below its union with the Jumna, and Allahabad at the point of junction.

Till within a recent period the magnificent stream of the Ganges formed almost the sole channel of traffic between Upper India and the seaboard. The products not only of the river valley, but even the cotton of the Central Provinces, used formerly to be conveyed by this route to Calcutta. Though the opening of the railway has caused a revolution in the channels of trade, heavy goods in bulk still follow the old means of communication; and the Ganges may still rank as one of the most frequented waterways in the world.

Great changes take place from time to time in the river bed and alter the face of the country. Extensive islands are thrown up and attach themselves to the bank, while the river deserts its old bed and seeks a new channel, it may be miles off. Such changes are so rapid and on so vast a scale, and the corroding power of the current on the bank so irresistible, that it is considered perilous to build any structure of a large or permanent character on the margin. Many decayed or ruined cities attest the alterations in the river bed in ancient times; and within our own days the main channel, which formerly passed Rajmahal, has turned away from it, and left the town high and dry 7 miles from the bank.

GAN'GES CANAL, an important irrigation work and navigable channel in the North-western Provinces of India, passing through the eastern portion of the Upper Doab, and watering a large tract of country from Hardwar to Cawnpore. As early as 1827 Captain Debude had proposed a plan for utilizing the waters of the West Kali Nadi, along an ancient line through the districts of Meerut, Bulandshahr, and Aligarh; but as practical difficulties would have prevented the realization of this scheme, Colonel Colvin in 1836 recommended the examination of the Ganges in the neighbourhood of Hardwar, where it emerges upon the plains from a gorge of the Siwaliks. The terrible famine which shortly afterwards (in 1837–38) devastated the Doab and caused an enormous loss of life and revenue, directed the thoughts of the government towards the desirability of providing against similar calamities in future. In 1842 the actual works were commenced by opening the excavation between Kankhal and Hardwar. After many delays caused by administrative changes or alterations of engineering plans, the Ganges Canal in its earliest form was opened in 1854. In 1866 a committee was again appointed to consider the advisability of further modifications, and their deliberations resulted in the construction of several new works, and the continuance of the main line towards Allahabad by means of a cut from Rajghat, known as the Lower Ganges Canal. The canal, as at present constituted, derives its supplies from the Ganges at Hardwar. The length of the main canal amounts to 519 miles. The minor

branches vary much from time to time, as new portions are opened or old channels disused. The total capital outlay on the canal has been over £3,000,000. The falls along the canal have been utilized in part as a motive power for mills, but much of the available power has never yet been employed. Navigation takes place along the entire length of the main canal, and consists in the rafting of timber or the carrying of merchandise in boats.

The Lower Ganges Canal may be regarded as a southward extension of the Ganges Canal, with which it has direct communication. Headworks draw their supply from the river at Narora, about 4 miles below Rajghat station of the Oude and Rohilkhand Railway. The main line crosses the Kali Nadi at Nadrai, and, running down the watershed between that stream and the Isan, is conveyed over the latter river and the Cawnpore branch of the Ganges Canal; thence it turns the head of the Pandu River, and flowing between that channel and the Rind, follows a course south of the East Indian Railway to Allahabad.

GAN'GLIA are nerve centres, such as those forming part of the sympathetic nervous system. In man there is a double chain of such nervous knots, with connecting fibres, running down the body for the length of the backbone, one set on each side of it; and these great chains of ganglia communicate with the spinal system of nerves. There are also some large ganglionic plexuses of nerves, the chief of which are the cardiac, the solar, and the hypogastric, respectively seated near the heart, in the abdomen, and in the pelvis. There are a large number of smaller ganglia distributed wherever nerve force has to be collected, as round the stomach, the intestine, the bladder, &c. The word ganglia is also applied to similar centres in the cerebrospinal system, such as those accompanying the sense organs, the ophthalmic (eye) ganglia, the otic (ear) ganglia, the submaxillary (tongue) ganglia, &c. And the posterior spinal nerves as they issue from the vertebræ carry ganglia at their roots; but there seems no good reason for supposing that these have the functions of true ganglia, storing nerve force, &c. They seem in some way to nourish the nerves. At the base of the brain are the great double ganglia of the cerebro-spinal system, the *optic thalamus* (the sensory ganglion, receiving the sense impressions of the whole body) and the *corpus striatum* (the motor ganglion, gathering the orders of the brain, and sending them out to the various parts of the body). The function of a nervous ganglion is to receive various nerve currents, co-ordinate them, and transmit them. In the minute structure of the retina or in that of the gray matter of the brain, &c., there are consequently always one or more layers of ganglionic cells to fulfil this function.

The sympathetic-system ganglia are peculiar in their power of not only receiving and transmitting, but also of acting upon nervous stimuli. They are true centres of nerve force, acting to a very large extent independently, thinking for themselves, so to speak. They all contain nerve fibres traversing them, as well as nerve fibres originating from them, namely from ganglionic corpuscles which they contain; and besides these corpuscles, others which do not give origin to nerve fibres also occur. Further, these ganglia work upon one another, continuing to cause movements necessary for the body, and it is only when much agitated that they call into use the fibres which connect them with the cerebro-spinal system.

GAN'GRENE is the loss of vitality in a circumscribed portion of the body, leading to the death of the part. It may be caused by intense inflammation, by mechanical injury, the extremes of heat or cold, arrest of circulation, or the effect of certain poisons on the system. It sometimes occurs and forms a dangerous complication in certain severe diseases, such as diabetes, typhus, typhoid, measles, and scarlatina. In that form of the disease known as dry or senile gangrene, the parts affected become red, hot, and painful, then dark-brown, and finally black and dead. It usually appears in the feet, the toes being first affected, sometimes appearing spontaneously or as the result of some trivial cause. The result is generally fatal, but sometimes the lifeless part separates from the limb, the place heals, and the patient survives. In the moist form of the disease the symptoms are of a more severe character, and the part affected becomes rapidly putrid and infiltrated with gas. The disease admits only to a slight extent of medical treatment, but attention must be directed to the prevention of its spreading, to the alleviation of the pain, and to the supporting of the strength of the patient. In some forms early amputation of the affected limb is necessary, but it is usual to wait until a line of demarcation between the living and dead portions is naturally established, when nature may be assisted by the removal of the latter.

GANGUE is the mining term used to designate the *non-metalliferous matrix* or *veinstone* that accompanies the metallic ore in a lode. The most commonly occurring gangues are QUARTZ, CALCITE, BARYTES, WITHERITE, FLUOR SPAR. CHALYBITE and PYRITES often occur as gangues to other minerals, though they are more strictly metalliferous ores.

GANG'WAY, a passage or temporary access to a building while in the course of erection, formed by an inclined plane of wooden planks, with pieces nailed across their surface to protect the feet from slipping; also a way or avenue into or out of any inclosed place, especially into or out of a ship, or from one part of a ship to another.

GANJAM' (*Ganj-amad*, a granary or depot), a district in the extreme north-east of the Madras Presidency, lying between 18° 15′ and 20° 15′ N. lat., and between 83° 49′ and 85° 15′ E. lon. The area is 8313 square miles, and the population 1,600,000. The district is mountainous and rocky, but interspersed with valleys and fertile plains. In shape it resembles an hour-glass contracted in the centre, where the Eastern Ghats nearly meet the sea, and widening out into undulating plains in the north and south. Pleasant groves of trees give to the scenery a greener appearance than is usually met with in the plains further to the south, while the rugged mountains, frequently covered with dense jungle, relieve the eye. A chain of fresh water or brackish lakes runs all along the coast, being separated from the sea by narrow strips of sand. Salt swamps and backwaters are also not uncommon. The channels of the rivers dry up in the hot season, but during the rains between June and November they are usually in full flood, and frequently overflow the country. Owing to the nearness of the Eastern Ghats to the sea, however, the floods subside with rapidity, and from the same cause the rise of the waters in the rivers is frequently so great as to cause considerable damage to property and not unfrequently loss of life. Sea and river fisheries form an important industry. The chief crops are rice, wheat, gingelly, castor-oil, rape, and several other varieties of grain; cotton, hemp, flax, jute, sugar-cane, tobacco, chilies, indigo, onions, and garlic.

The town of GANJAM, formerly the capital of the district to which it gives its name, is situated at the mouth of the Rushikulya River, 697 miles north-east of Madras, and 315 miles south-west of Calcutta. It was formerly a seat of considerable trade, but since the removal of the headquarters of the district in 1815 it has declined in size and importance. The removal was caused by an epidemic fever which carried off a large proportion of its inhabitants, both European and native. The sanitary condition of the town has been much improved of late. While it remained the chief town Ganjam was remarkable for the magnificence of its European residences. Some of these still exist, as also the remains of the old forts. The government salt manufacture forms now the principal industry.

GAN'NET, or **SOLAN GOOSE** (*Sula bassana*), is a large sea bird belonging to the Pelican family. It is a native of the rocky coasts and islands of northern Europe. St. Kilda, and the Bass Rock in the Frith of Forth, are its chief strongholds. Besides these islands it has other breeding stations, as Ailsa Craig at the mouth of the Frith of Clyde, some of the Orkneys and Hebrides, the Skellig Isles on the Irish coast, and some small islands off Iceland. Its only breeding place in England is Lundy Island, in the Bristol Channel. In North America it breeds in the Bay of Fundy and the Gulf of St. Lawrence.

The gannet is migratory, arriving at the Bass Rock and other places of resort about the end of March, in vast flocks, for the purpose of incubation. Thousands incubate in harmony together. The nest is composed of withered grasses and sun-dried seaweeds, and the female lays only a single egg. When first hatched the young are quite destitute of down, and the skin is of a dark lead colour; in a few days, however, a white down makes its appearance, and soon becomes so thick and full that the nestlings look like powder-puffs. In about two months the young are fledged.

The Bass Rock and St. Kilda may be regarded as regular gannet-farms. The young are taken in great numbers, not only for the sake of the down, but also of the flesh, which, though somewhat oily and rank, is esteemed as a relish when roasted. The eggs also are highly prized by many, and it is said that 22,000 birds, and an

The Gannet (*Sula bassana*).

immense quantity of eggs, are consumed in St. Kilda alone. The young are cured and dried for winter consumption. During incubation, in consequence of being unmolested, these birds become very tame, and where the nests are easily accessible will allow themselves to be stroked by the hand without resistance or any show of impatience, except the low guttural cry of *grog, grog*.

During the months of May and June the surface of the Bass Rock is almost covered with the nests, eggs, and young of the gannet, so that it is scarcely possible to walk without treading on them. The flocks rise in clouds, and make such a deafening noise that it is almost impossible to hear the voice of a person close at hand. The sea all round is covered with them, and the flocks in the distance can only be compared to swarms of bees. From its buoyancy, arising from length of wing and an arrangement of most extensive subcutaneous air-cells, the aerial powers of the gannet are extraordinary. When in search of prey it soars usually at a considerable elevation, surveying the surface of the water with its piercing glance; and as soon as it perceives the fish within reach it plunges down with tremendous force and rapidity, pounces upon its victim, and rises again into the air with surprising ease and address. Gannets, indeed, have been taken by means of a fish fastened to a board, sunk to the depth of 2 fathoms, against which, so violent has been the shock of the bird, its neck has been instantly dislocated, and the bill firmly fixed in the wood. The food of the gannets consists chiefly of herrings, pilchards, and sprats, which, swimming in large shoals and always near the surface of the water, insure them a good supply of food; indeed when the fishermen see a flock of these birds busily engaged they know at once where to direct their boats. On the approach of autumn the gannets move southwards, and in winter are met with in great abundance in the Bay of Biscay and the Mediterranean, where the anchovy and sardine afford them an ample supply of food.

The general colour of the adult gannet is white. The top of the head and back of the neck are tinged with yellow; the quill-feathers black; the bill bluish-gray; the naked skin round the eyes dull blue; the skin of the throat black; the webs of the toes dusky; a bluish streak extends along the tarsus and upper part of the toes. In length the gannet is 2 feet 10 inches.

The plumage of the young birds is as follows:—*First year:* general colour above blackish-gray, inclining to clove brown, each feather being tipped with a triangular spot of white; under surface white, the feathers being edged with grayish-black; quill and tail feathers grayish-black, the shafts of the latter being white. *Second year:* head and neck white, more or less spotted with blackish-gray; upper plumage clove brown, the triangular spots on the tips of the feathers becoming indistinct; under plumage white. *Third year:* the white increases all over the body, the long scapulars and tertiaries remaining black, or spotted with blackish-gray; the head begins to acquire the sienna yellow tinge. In the *fourth year* the adult plumage is assumed.

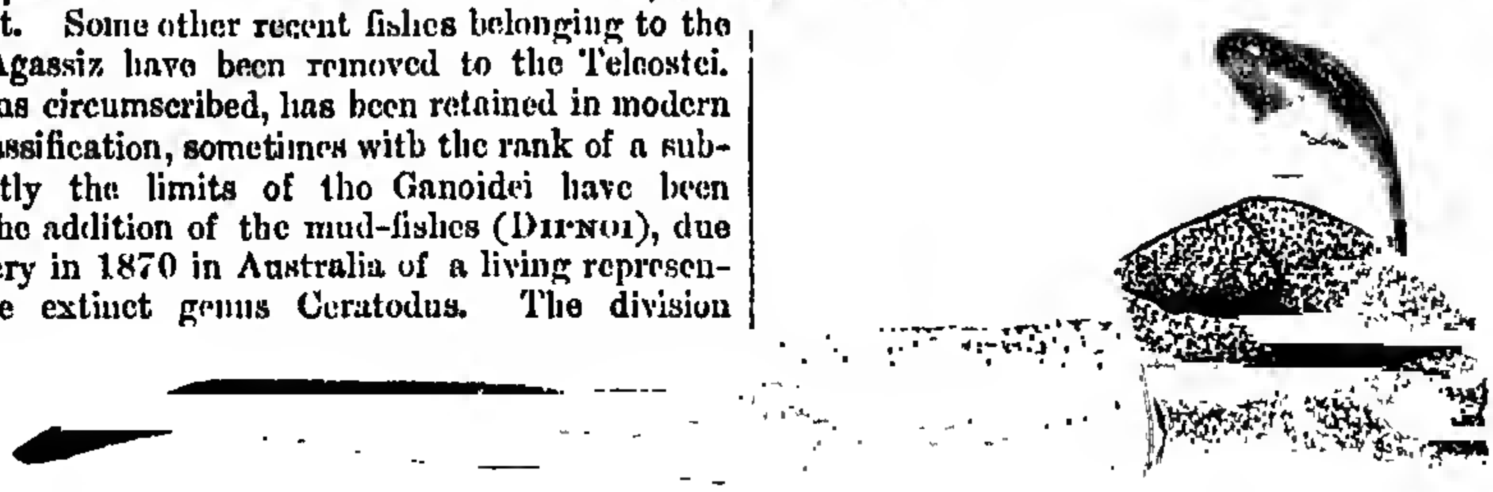
The name gannet is cognate with the English *gander*, German *gans*, Latin (*h*)*anser*, Greek *chen*, Sanskrit *hamsa*, all of which mean goose. Various suggestions as to the etymology of the word solan have been made, none of which are satisfactory. To several species of the genus Sula, especially *Sula fusca*, the name BOOBY is applied, with manifest reference to the stupidity of these birds.

GAN'NISTER, of Yorkshire, is a compact silicious bed, forming the floor of some coals in the lower coal measures of the north of England. The name has, however, been extended to, and is now used synonymously with lower COAL MEASURES, which lie between the millstone grit and the middle coal measures of the north of England and Wales. In Lancashire they consist of a series of flagstones, shales, and thin coals, from 1400 to 2000 feet thick, containing Orthoceras, Goniatites, Posidonia, Aviculopecten, Lingula, &c. Most of the forms are of marine species, some of the more characteristic being *Goniatites listeri*, *Lingula squamiformis;* but some of the remains are of those inhabiting brackish water, as Anthracosia.

GAN'OID SCALES (Gr. *ganos*, brightness), hard, angular, horny scales, covered with a layer of enamel. These scales are usually rhomboidal or quadrangular in shape. They are arranged edge to edge in oblique rows, the scales of one row being linked together by a distinct process. Ganoid scales are most common in fossil fishes. See following article.

GANOID'EI is one of the great divisions into which FISHES are divided. The establishment of this division of fishes was due to Agassiz, who in his study of fossil fishes was so struck with the fact that the peculiar scales of Lepidosteus (bony pike) and Polypterus were common to all fossil fishes from strata below the chalk, that he classified fishes into four orders according to the structure of the scales—Placoids, Ganoids, Ctenoids, and Cycloids. The artificial character of this classification, so far as recent

fishes were concerned, was soon perceived. In the Ganoids, however, were brought together such recent forms as the sturgeons and the bony pike, between which a close relationship, independent of the character of the scales, was shown to exist. Some other recent fishes belonging to the Ganoids of Agassiz have been removed to the Teleostei. The order, thus circumscribed, has been retained in modern systems of classification, sometimes with the rank of a subclass. Recently the limits of the Ganoidei have been widened by the addition of the mud-fishes (DIPNOI), due to the discovery in 1870 in Australia of a living representative of the extinct genus Ceratodus. The division

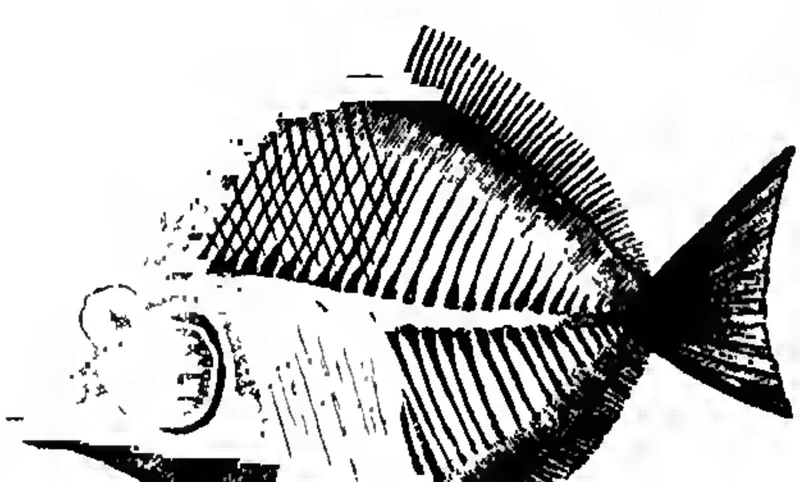


Coccosteus cuspidatus.

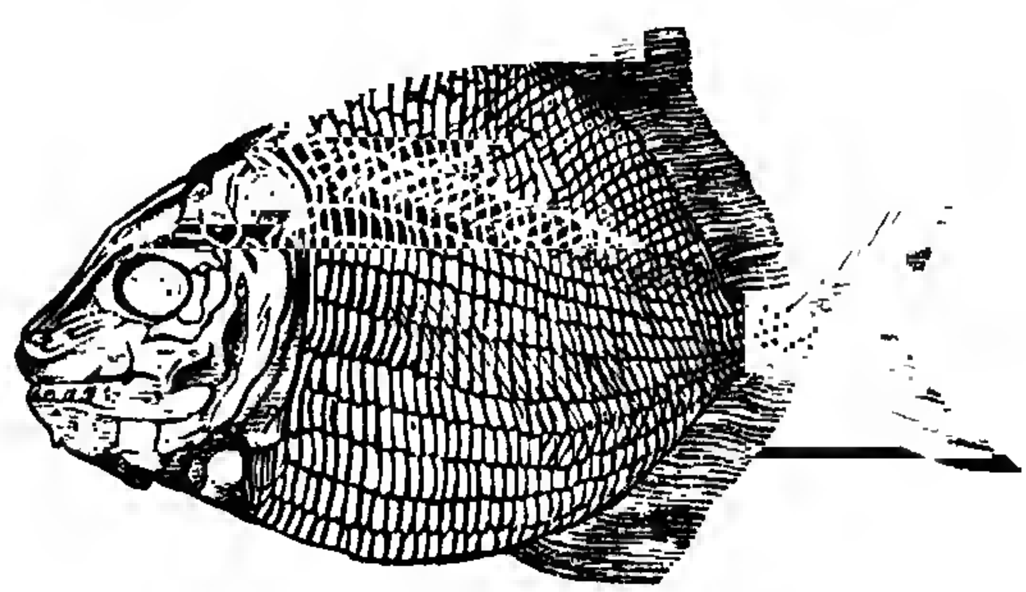
Pterichthys oblongus.

Ganoidei, as now constituted, includes a few recent fishes and a vast number of fossil forms of the Primary and Secondary ages, the knowledge of which is necessarily very incomplete. The Ganoidei are in many ways intermediate between the cartilaginous fishes (Chondropterygii, sharks and rays) and the bony fishes (Teleostei). The skeleton is variously ossified. The gills are free, and the gill-openings are provided with a gill-cover (operculum). The structure of the heart is similar to that of the sharks, the dilation above the ventricle from which the branchial artery starts being a *conus arteriosus*, not separated from the ventricle by valves, and having its interior provided with a series of watchpocket-shaped valves. The intestine is provided, as in the sharks, with a spiral valve. The ducts of the generative and urinary systems coalesce towards their end. A large air-bladder is present having a persistent duct. The air-bladder of the Dipnoi acts as a lung, and in some genera is completely divided into two cavities. The ventral fins are always abdominal.

Dr. Günther unites the Ganoidei with the Chondropterygii to form the great subclass Palæichthyes. He divides Ganoidei, which ranks as an order, into eight suborders. The first, PLACODERMI, is wholly extinct; it includes several species of great interest (see woodcuts) from the Old Red Sandstone (Devonian) of Scotland. The head and upper part of the body were encased in great bony sculptured plates with dots of enamel; these plates are



Pycnodus rhombus.

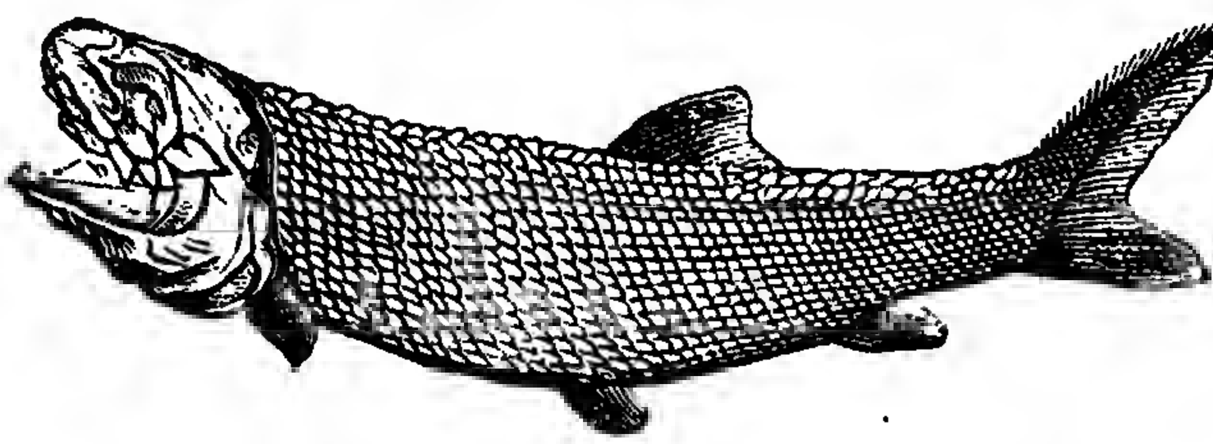


Platysomus striatus.

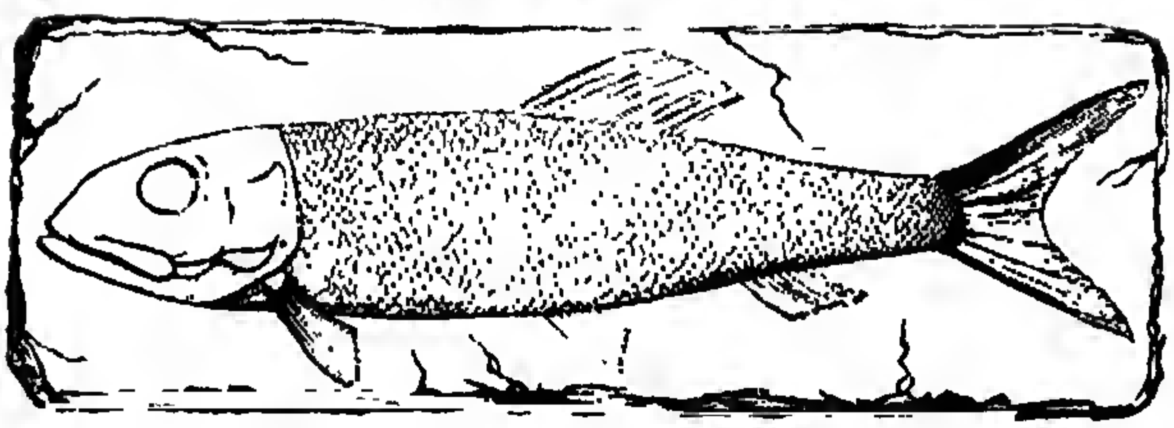
firmly united so as to form a large buckler not unlike the carapace of a crustacean; the rest of the body was naked or covered with ganoid scales. The notochord was persistent. The Acanthodini contains a few genera, from Devonian and Carboniferous formations. The body was covered with very small shagreen-like scales. The front of the fins was provided with a large spine similar to the fin spines of sharks. The skull was not ossified. The caudal fin was heterocercal. The DIPNOI or mud-fishes are often separated from the Ganoids. They are of great interest from the approximation which they make to the Amphibia. This group contains three recent genera. The air-bladder is modified so as to form a lung and assist in the process of respiration; gills are also present. The notochord is persistent. The fourth suborder, Chondrostei (STURGEONS), contains most of the recent Ganoids. The notochord is persistent and the skull cartilaginous, with superficial ossifications. The caudal fin is eminently heterocercal. For examples of this group see Plate GANOIDEI, figs. 2–6, showing the Common Sturgeon, the Sterlet, and the grotesque Paddle-fish. Of the next group, Polypteroidei, out of a great number whose remains abound in the Devonian and coal formations only two species survive—*Polypterus bichir* (Plate, fig. 1), found in Western Africa [see POLYPTERUS], and *Calamoichthys calabaricus*. The vertebral column has fully ossified

amphicœlous (concave at both ends) vertebræ. The body is covered with ganoid scales. Among the extinct forms are Holoptychius and Osteolepis. The pectoral fins, and usually the ventral, consist of a pointed axis with rays on each side. The sixth suborder, Pycnodontoidei, is wholly extinct. These fishes had a compressed rhomboidal body covered with rhombic scales, the notochord persistent, and molar-like teeth on the palate and hinder part of the lower jaw. These fishes are abundant in beds of Secondary age. The species figured, *Pycnodus rhombus*, is Oolitic.

The seventh group is Lepidosteoidei, the typical genus of which is Lepidosteus (Bony Pike); there are three recent species of this genus inhabiting America. The vertebræ are fully ossified and opisthocœlous (convex in front and concave behind). The body is covered with



Palæoniscus frieslebeni.



Leptolepis sprattiformis.

ganoid scales. Among the extinct genera are Platysomus from the Coal and Palæoniscus from the Permian formations. The eighth suborder is Amioidei, containing only one recent species, *Amia calva*, found in fresh waters in the United States of America. The vertebræ are fully ossified and amphicœlous. The body is covered with cycloid scales. The caudal fin is homocercal. The species figured is from the Oolites.

GAN'YMEDE (Gr. *Ganumedes*) was an extremely beautiful boy, according to the Greek myth, whom Zeus so admired that he sent his eagle to carry him bodily to Olympus, there to become his cup-bearer.

GAOL DELIVERY. The commission of gaol delivery is directed to the justices of assize of each circuit, the serjeants and queen's counsel attending that circuit, the clerk of the assize, and the judges associate. It is a patent in the nature of a letter from the queen, constituting them her justices, and commanding them, four, three, or two of them, of which number there must be one at least of the judges and serjeants specified, and authorizing them to deliver her gaol at a particular town of the prisoners in it; it also informs them that the sheriff is commanded to bring the prisoners and their attachments before them at a day to be named by the commissioners themselves. Under this commission the judges may proceed upon any indictment of felony or trespass found before other justices against any person in the prison mentioned in their commission and not determined, in which respect their authority differs from that of justices of oyer and terminer, who can proceed only on indictments found before themselves.

Anciently it was the course to issue special writs of gaol delivery for each prisoner, which were called writs *de bono et malo;* but a general commission has long been established in their stead.

GAOL DISTEMPER. During some trials in the old court at the Old Bailey in 1750, the lord mayor, one alderman, two judges, the greater part of the jury, and numbers of spectators, caught the gaol distemper and died. It also proved fatal to several in 1772. It is now known that the disease was Typhus Fever. See Black Assize.

GAP, a town of France, in the department of Hautes Alpes, is the *Vapincum* of the Romans, and was also the capital of the former province of Dauphiné, is situated on the Luie, 418 miles S.E. of Paris, by the road through Lyons and Grenoble. It is an ill-built and much decayed town, with a population of 8918. There are a college, tribunal of first instance, several churches, one of which is of the reformed religion, a seminary, a museum, and a theatre in the town. The most remarkable buildings are the cathedral, which contains the mausoleum of the Duc de Lesdiguières, and the town-hall. Coarse cloth, calico, serge, hats, and cutlery are manufactured, and the trade of the town is in these articles, and in grain, fruit, cattle, and wool. Near the town is the Lake of Pelhotiers, in which there is a floating island.

GAPES, a disease often fatal to barn-door fowls. It is thus named because the birds affected constantly open their mouths, as if making an effort to exclude something from their throat. It is caused by the presence of a small thread-like worm (*Fasciola trachealis*) in the trachea or windpipe. The speediest cure is to thrust an oiled feather quickly into the windpipe, and to dislodge the entozoan, which is then coughed up. Epsom salts, or urine mixed with the food, is also used as a cure.

GAR'ANCIN, a red dye obtained from the root of madder (*Rubia tinctoria*) by treating it with concentrated sulphuric acid. It forms a reddish-brown powder, and was imported in enormous quantities for dyeing, especially for turkey-red goods. The active principle is alizarin. This colour, on which the sulphuric acid does not act, is now obtained artificially from anthracene derived from coal tar, and is therefore one of the extensive series of colours now obtained from that source. The artificial alizarin exceeds the natural product in beauty of colour, and in giving several new shades. The import of garancin is now trifling, and thousands of acres hitherto devoted to the growth of madder are diverted to other crops. See Alizarin.

GARCIN'IA. See Mangosteen.

GARD, a department in the south of France formed out of portions of Bas Languedoc. It is bounded N.W. and N. by Lozère and Ardèche, E. and S.E. by Vaucluse and Bouches-du-Rhône, S. by the Mediterranean, S.W. and W. by Hérault and Aveyron. The form of the department is irregular; its greatest length from E. to W. is 76 miles, from N. to S. 72 miles. The area is 2253 square miles, and the population 415,629. A large proportion of the inhabitants are Protestants, who have consistorial churches in all the principal towns of the department.

The north-western part of the department is occupied by the branches of the Cévennes, of which the principal ridge is for the most part beyond the boundary of the department. From this part the face of the country gradually declines to the south-east, in which direction the principal rivers flow to the Rhône and the Mediterranean.

The coast and the lower banks of the Rhône are lined with étangs, or pools, of considerable size.

The principal rivers are—the Rhône, which bounds the department on the east, and its tributaries from the right bank, namely, the Ardèche; the Céze, which drains the north of the department; the Gard, which gives name to the department, drains its central districts, and falls into the Rhône a little above Beaucaire: it is formed by the junction of three streams which rise in the Cévennes, in the department of Lozère, and are distinguished by the names Gardon d'Alais, Gardon d'Anduze, and Gardon de Miaulet. These rivers all rise in the Cévennes; they are subject to inundations, which sometimes cause great ravages. The Vidourle flows south from its source near Le Vigan into the étang of Mauguio, in the adjacent department of Hérault. The Vistre, which flows near Nimes, and the Rbosny, which flows near Aymargues, unite and serve as feeders to the Radelle Canal. The Hérault and some of its tributaries, and also the Dourbie, an affluent of the Tarn, have their sources in the department. Of these rivers only the Rhône and the Ardèche are navigable.

The department is traversed by a navigable canal from the Rhône at Beaucaire to Aiguesmortes, the principal town in the south of the department, which communicates with the Mediterranean by the Grande Robine Canal and the Grau (a harbour formed by dykes running into the sea), and by the Rodelle Canal with the Canal des Étangs, which last joins the Canal du Midi at Cette. There is another branch-canal, that of Bourgidon, from Aiguesmortes to the canal of Sylveréal, by which the navigation of the most western branch of the Rhône is facilitated. The length of canal navigation in the department is about 50 miles. There is also good railway accommodation.

Important iron, coal, and silver lead mines are worked. Silver, copper, and calamine are found; but the working of the mines has been abandoned. Sulphate of iron, manganese, kaolin, antimony, fullers' and potters' clay, plaster of Paris, building stone, &c., are also found.

The air in this department is commonly mild; but in March and April considerable changes of temperature are experienced within the twenty-four hours. In June, July, and August the heat is very great, the maximum being 99° Fahr. The department is scourged by the wind called *mistral*, and, when this does not blow, by clouds of mosquitoes during the hot weather. The autumn is usually dry and cool. The greatest cold is commonly at the end of December.

Besides wheat the other grains cultivated are oats, rye, barley, maize, millet, and buckwheat. Lentils, pease, and potatoes are grown; but the main support of the peasantry are chestnuts, of which immense quantities of excellent quality are produced on the slopes of the Cévennes. The vine is extensively cultivated all through the department, which yields annually about 27,000,000 gallons of good strong wine, one-fourth of which is consumed at home, one-sixth is distilled into brandy, and the remainder is exported through Cette, chiefly for the purpose of mixi with the poorer wines of more northern departments. The olive, too, is carefully cultivated in sheltered spots, and on the southern slopes of the hills; the oil of the department is in high repute. The cultivation of the mulberry, which here becomes a large and beautiful tree, is very extensive. Cherries, apricots, peaches, figs, pomegranates, &c., are abundantly produced. Indeed the chief agricultural wealth of the department consists in its wines, oil, silk, and delicious fruits. Medicinal herbs, madder, and other dye-stuffs are grown.

Only a small number of oxen are reared; but sheep are numerous, and their wool is very fine. The horses are small, but vigorous and lively. Among the wild animals are wolves, foxes, otters, beavers, eagles, vultures, wild ducks, ortolans, red partridges, storks, bustards, &c.

The industrial products of the department are varied and important. The principal are silk textures of all kinds, the chief seat of which is Nimes; cashmere shawls, made of a mixture of Tibet wool, silk, and cotton; silk and cotton hosiery of every description; table-covers, carpets, &c.; woollen cloth, swanskins, blankets, shoe and glove leather; silk hats; ribbons and gloves; iron, steam machinery, wine casks; pottery, tiles, and bricks; glass, paper, cards; nails, plaster, and lime; cotton and woollen yarn; salt, soda. The commerce of the department consists of the various products already mentioned.

The department is divided into four arrondissements—Nîmes, which contains the chief town, Alais, Uzès, and Le Vigan. The antiquities in the department belong principally to the Roman period. The most important are the amphitheatre at Nimes and the *Pont de Gard*. The latter is an aqueduct, and one of the most splendid relics of the Roman power, built over the Gardon, about 10 miles north-east of Nimes. After the decline of the Roman power the Vandals, Visigoths, Saracens, and Franks successively possessed this department.

GARDA, LAKE OF (the ancient *Benacus*), the largest of the Italian lakes, lies between the provinces of Brescia and Verona. Its southern coast belongs to the province of Mantua, and its northern extremity enters the territory of Trent in the Tyrol. Its length is about 35 miles, and its greatest breadth in its southern part is 11 miles, but at the northern end it is not 3 miles wide. It receives at its northern extremity the river Sarca and several other streams. The Mincio issues from its south-east extremity by the fortress of Peschiera. Some account of the territory along the banks of this lake is given under Brescia and Verona. The lake has some small islands near its west coast. Its waters have a dark blue colour, and it contains fish in great variety, which form an important article of trade. In summer, from the melting of the Alpine snows, it rises 4 or 5 feet, and like all similar inland waters is subject to violent storms.

GARDE NATIONALE. During the French Revolution of 1789 this celebrated citizen army was formed by the leaders of the Revolution without consulting the government. It numbered in the first instance 48,000 burghers of Paris, and was named the Parisian militia; Lafayette was chosen commandant. In a short time citizen troops were organized in every important town of France, and the entire force numbered more than 300,000. The National Guard generally proved to be the defenders of order through the course of the Revolution, rescuing the royal family on the 11th of October, 1789; firmly withstanding the more violent insurrectionists for some months after; faithful to the Convention in 1794; and aiding in taking away the arms from an excited mob in 1795. But occasionally swerving from this course, we find it in the early part of 1794 among the most devoted adherents of Robespierre; and in 1795 going to the opposite extreme, and becoming royalist in its feelings, and rebelling against the Convention; but in this last excess they were defeated by a small body of the regular troops under Barras and Napoleon. The latter declined the offer of the command of the National Guard which was made him by Robespierre.

By a decree issued by Napoleon I. on 23rd September, 1805, every man in good health, and between the ages of twenty-one and sixty, was required to serve in the National Guard, and the officers were named by the emperor. During the Revolution of 1830 the members of this body were among the most formidable opponents of Charles X., who had attempted to dissolve the force. In that year it was re-established under Louis Philippe, with Lafayette as commander-in-chief. In the critical period of 1848 the Paris guard joined the revolutionists, and helped to put an end to the Orleans dynasty. In 1852 the Garde Nationale was dissolved and reorganized on a more military

basis in a part of the departments only. The emperor selected the officers, and exercised discretionary powers as to the formation or dissolution of any part of the force. For fear, however, of placing arms in the hands of the people, the drill and equipment of the National Guard were much neglected during the second empire, and when the country was invaded by the Germans in 1870 the force was comparatively useless. Great excesses were also committed by portions of it during the siege of Paris, and the establishment of the Commune was due in a great measure to the counsels of its more turbulent members. In the settlement of the military system of France in 1872 the National Guard was entirely abolished.

GARDEN. A garden, as distinguished from a farm, is a piece of ground designed for the cultivation of plants not actually indispensable to man for food.

The possession of a garden is one of the earliest indications of civilization in man. It may be fairly considered that the taste for gardens has been at all times commensurate with the wealth of nations generally, their peaceful habits, and advance in the social relations of life.

The first great step that was made by gardeners to advance their art beyond mere mechanical operations was the invention of glass-houses, in which plants might be grown in an artificial climate and protected from the inclemency of the weather. Until this was effected it is obvious that the cultivation of exotic plants in Europe, especially its northern kingdoms, must have been much circumscribed. Mr. Loudon refers the invention of greenhouses to Solomon de Caus, architect and engineer to the elector palatine, and who constructed the gardens at Heidelberg in 1619. But there is no doubt that buildings of this description claim a higher antiquity. The *specularia* of the Romans were certainly used for the purpose of forcing roses and some other plants, they were essentially greenhouses, although perhaps more like our garden-frames. Greenhouses were in use among the Italians in the middle of the sixteenth century, though probably without artificial heat. If heat was required it would be supplied by stoves or such other means as were used for domestic purposes. Ray says that in 1684 the greenhouse in the Apothecaries' Garden at Chelsea was heated by means of embers placed in a hole in the floor; and it appears from a section of a greenhouse in the electoral garden at Mannheim, given in "Medicus Index Plantarum," that a German stove was used there as late as 1771. We, however, agree with Mr. Loudon in considering the invention of glass roofs for greenhouses to be an era from which the principal part of modern improvements takes its date. This happened in 1717. Up to that time the want of light must have rendered it impossible to employ greenhouses for the growth of plants, either in winter or summer; they could only have been hybernatories, receptacles in which plants might be protected from wet or cold during winter, but from which they were transferred to the open air as soon as the spring became sufficiently mild. The substitution of glass roofs, by increasing the quantity of light, put it at once in the power of the gardener to cultivate permanently in his greenhouse those natives of hot countries which are not capable of bearing the open air of Europe even during the summer. Since then there has been a gradual improvement in the construction of greenhouses, the object being to supply the plants with as nearly the same amount of light when under the glass roof as they would have had in the open air. The modern invention of curvilinear iron roofs has accomplished this end in a most remarkable degree; for they substitute an obstruction to light amounting to only $\frac{1}{23}$ or $\frac{1}{24}$ for a loss equivalent to $\frac{1}{4}$ or even $\frac{1}{2}$.

The mode of heating such houses is usually by furnaces and flues, but it is often now done by steam, or by hot water led through the house in tubes, or by hot air admitted into the atmosphere of the house. In addition to these improvements the rapid and uninterrupted communication now existing between all parts of the world has placed the plants of various climates within the reach of all those who take delight in their cultivation; and another important reason for the present flourishing condition of European gardens may be seen in the extension of the education of the working gardener. Great numbers of gardeners are now well informed in the higher branches of their profession. Instead of trusting to certain empirical rules, or to *recipes* for gardening operations, they make themselves acquainted with the principles upon which their operations are conducted; they acquire a knowledge of botany and vegetable physiology, and some even add physical geography; and thus they place themselves in the only position from which they can securely advance to the improvement of their art.

The restoration of gardens took place among the nobles of Italy, and many fine instances of wealth and taste applied to such purposes still remain. Those of Naples, Florence, and Monza, and especially the Isola Bella, near Milan, are the most remarkable.

The Dutch, although too much attached to the stiff formal style of clipped hedges, straight walks, and architectural puerilities, have always had a great reputation as gardeners. Their wealth and their commerce with the Cape of Good Hope and the East Indies gave them for a while extraordinary advantages over other nations. For a long time the garden of Leyden was considered the richest in Europe, and there are few that surpass it at the present day. The rage for tulip bulbs among the Dutch reached the height of a passion in the seventeenth century. Fabulous prices were given for rare varieties. The Dutch are still the great bulb growers of the world.

In Belgium there are small public gardens, both at Antwerp and Ghent, and one of the finest in Europe is at Brussels. It contains a range of hothouses 400 feet long, ornamented with a rotunda and porticoes, and an extensive collection of plants.

Among the German princes a taste for gardening has grown up in a degree unknown in any other country except among the English. The most remarkable gardens are those of Munich, Berlin, and Vienna.

Rivalling these are the gardens of St. Petersburg, founded by the late Emperor Alexander on Apothecaries' Island in the Neva. In a country with such a climate as Russia gardening can hardly exist except under glass roofs, and it is necessary to call in aid all the resources of art in order to overcome the difficulties of nature. It is not surprising, then, that in this situation the glass-houses should exceed in extent those of all other parts of Europe. Altogether there are 3624 feet of such buildings, forming a double parallelogram, the principal sides of which are 700 feet long and from 20 to 30 feet wide. The middle range is 40 feet high in the centre.

In France gardening has never been in a very flourishing condition. It is true that great quantities of vegetables are raised for the market, that the fruits of France are justly celebrated for their excellence, and the flower-markets of Paris are well supplied; it is also true that numerous excellent works on gardening have been written in France. In flowers their taste is more that of the Romans than of other European nations, for they are contented with a few showy kinds of sweet-smelling flowers, especially roses. The Jardin des Plantes at Paris, which is the largest of the public establishments in France to which the name of garden properly applies, is not an exception to this statement, so far as the plants it contains are concerned; and there are few judges who would assign to it a place among the first class of European gardens.

The Royal Botanic Gardens at Kew, 7 miles from London, contain the largest and most choice collection of plants, both native and exotic, in England. They have been

arranged with great skill and care. The hothouses and conservatories are very numerous. There are also a palm-house, 362 feet by 100, and 60 feet high, two greenhouses nearly as large, and a museum. The gardens extend over about 75 acres, and the pleasure grounds connected with them to 240 acres. The expense of the gardens is defrayed out of the public purse, and a very liberal management has for many years been pursued.

The Royal Horticultural Society was established in 1808, and possessed a large experimental garden at Chiswick till the year 1860, when it was replaced by a new garden at Kensington Gore, at a cost of £100,000. The early progress of the society was very rapid and its usefulness great, but during its later years at Chiswick it somewhat degenerated, and it was a failure at Kensington. A very successful establishment of a nearly similar kind is the Royal Society's Botanic Garden, which occupies the inner circle, an area of 18 acres, in Regent's Park. It has a very spacious conservatory, greenhouses, and an excellent collection of plants.

The Botanic Garden of Edinburgh is one of the finest and best managed in Europe. It consists of 16 acres, delightfully situated, and includes everything that can be required for the purposes of teaching. The houses are remarkably good, and the healthy condition of the plants deserving of all praise. It is particularly celebrated for its beautiful specimens of heaths. Besides these, there are botanic gardens at Dublin, Glasgow, Liverpool, Cambridge, and Oxford; fine public gardens in Sheffield, Manchester, Birmingham, and other large towns; and a garden at Chelsea belonging to the Apothecaries' Company, who maintain it for the use of medical students of the London schools. Horticultural societies now exist in almost all the towns and in many of the villages and rural districts of Britain. They have done much to promote the growth of flowers, fruit, and vegetables, and have also fostered a taste for gardening among the humbler classes. There are many rose societies, more particularly in the south of England, specially devoted to the cultivation of the garden rose; and their exhibitions are always among the favourite fêtes of the neighbourhood. A considerable professional element enters into the National Rose Society, and into the magnificent yearly rose show at the Crystal Palace, when the whole vast nave is full of the flowers. As a result the rose has been of late years brought to a perfection hitherto not dreamed of.

GARDEN HUSBANDRY is a branch of horticulture the object of which is to raise fruits, vegetables, and seeds for profit on a smaller extent of ground than is usually occupied for the purpose of agriculture.

The best examples of this kind of industry are found among the market-gardeners near populous towns, particularly London, Paris, and Amsterdam. By the application of much manual labour, and an abundant supply of manure, they greatly accelerate the growth of vegetables.

The market-gardens near London have a soil which is a moist alluvial loam, deposited from repeated overflowings of the Thames, which are now prevented by banks or dykes. The gardener's year properly begins in autumn, when the land is dug, or rather trenched, and well manured. Various vegetables which will be required in winter are then sown, and especially those which are to produce plants to be set out in spring; spinach, onions, radishes, and winter salads are sown, and when the weather is severe are protected by a slight covering of straw or mats. In February the cauliflowers, which have been raised in frames or under hand-glasses, are planted out. The cabbage plants are pricked out. The radishes, onions, and salads are sent to market as soon as they are of sufficient size, and sugar-loaf cabbages succeed them. As the cauliflowers are taken off they are succeeded by endive and celery, and the same is the case with the cabbages. Thus there is a constant succession of vegetables, without respite to the ground.

The principle on which the gardens are cultivated is that of forcing vegetation by means of an abundant supply of dung, constant tillage, and occasional watering. The whole surface is converted into a species of hotbed, and crop succeeds crop with a rapidity which is truly astonishing. Those vegetables which arrive at a marketable state in the least time are always the most profitable, and those also for which there is a constant demand at all times of the year. With an abundant supply of manure, the market-gardeners have no fear of exhausting the soil; and dissimilar vegetables may grow together on the same ground. Raspberries, gooseberries, and currants are planted in the rows between fruit trees, which rows being 30 or 40 feet apart leave ample room for vegetables. The market gardeners near London do not raise many pease or beans, except such as are forced and require glass frames to protect them. The chief supply of pease in the season comes from a greater distance, and is the produce of whole fields sown for that purpose by the farmers within a moderate distance of London.

A garden should always be laid out in a regular form, with narrow parallel beds, and paths between them. One or more roads, of sufficient width to allow a cart to pass, should intersect these beds at right angles, for the convenience of bringing manure and taking off the produce. The beds should not be above 6 feet wide, so that a person may easily pull up weeds or gather the vegetables without treading upon the beds. For early plants, and those which are used in winter and require to be protected from frost, narrow beds are made lying in a direction east and west, and sloping towards the south, with the north side raised high, so that their surface forms an angle of twenty or thirty degrees with the horizon. In very frosty weather these beds are covered with mats or loose straw.

An abundant supply of manure is indispensable in a market-garden, and this can generally be obtained in large towns at a trifling expense. The neighbourhood of a town is therefore a favourable circumstance towards the production of the crop as well as its sale.

In some agricultural districts it is the custom for the labourers to plant turnips in their gardens in November, in order to obtain the seed in time for sowing in the next year. An industrious cottager, without losing any time, with the help of his wife and children, may much increase his comforts in this manner, while at the same time he trains his children to habits of industry. To no class of men would a knowledge of garden husbandry be more useful.

Many plans have been proposed for the distribution of the crops in a cottage garden, but none of them are suited to every situation. Much depends on the nature of the soil, which may be better suited to one kind of produce than another, and also to the demand for any peculiar class of vegetables. The practice of the market-gardeners may be examined with advantage; and long experience, with the test of profit, will lay down better practical rules than the most plausible theories.

An allotment of land such as is now very frequently rented by agricultural labourers may be cultivated to great advantage by applying judiciously the general principles of garden husbandry. There are few cottages which have not already attached to them a small garden of a few perches, in which common vegetables, such as cabbages, onions, and early potatoes, are raised. But the remainder of the allotment should be cultivated on a regular plan, as a farm in miniature, with this difference, that all the operations should be performed with the minute attention of a gardener. Potatoes and wheat, if the soil is not too light for the latter, or rye, in very sandy soils, will be the principal crops, being immediately necessary to the support of the family. Large gardens connected with gentlemen's seats are generally divided into the departments of flower, fruit, and kitchen garden. A wall, either of brick or stone, is the best

inclosure, as wall-trees can be trained upon it. Nurseries are gardens devoted to the raising of young plants, trees, herbs, and garden seeds.

GARDE'NIA, a genus of plants belonging to the tribe Cinchoneæ, and order RUBIACEÆ. *Gardenia campanulata*, a shrub from 5 to 20 feet in height, is a native of Sikkim, Assam, Chittagong, and Pegu. The berry is about the size of a golden pippin apple, and is employed by the natives of India as a cathartic and anthelmintic. *Gardenia arborea* is a native of the East Indies. The fruit is eaten by the natives of India. It is one of the most beautiful species of the genus, and deserves a place in every collection. By Hooker it is considered to be the same as *Gardenia gummifera*. *Gardenia lucida* is a native of India and Burma. A fragrant resin is obtained from the tree, which is useful in hospitals, as it keeps away flies from sores on account of its strong aroma. *Gardenia florida* is a native of Japan and China with very strongly scented flowers. The orange pulp of the fruit is used as a dye.

There are about sixty species of Gardenia, which all bear elegant sweet-scented flowers. They thrive best in a mixture of loam, peat, and sand. Under the name of Cape jasmines, doubled-flowered varieties of *Gardenia florida* and *Gardenia radicans* are extensively cultivated. Their flowers are very fragrant, and the best way of getting them to bloom freely is to set them in a close frame with a gentle bottom heat in the spring. In the winter they may be placed in the greenhouse. They may be increased by cuttings.

GARDINER, STEPHEN, a celebrated English prelate, was believed to be the illegitimate son of Dr. Woodville, bishop of Salisbury, who, being brother to Elizabeth, Edward IV.'s queen, was also related to Henry VIII. He was born at Bury St. Edmund's in 1483, and studied at Trinity Hall, Cambridge. Through his intimacy with the Duke of Norfolk, while master of Trinity Hall, he became secretary to Wolsey, and was thus introduced to the king, who rapidly took him into favour. Dr. Stevens (as Gardiner at this time was usually called) was sent to Italy in 1527 to procure the pope's consent to the divorce of Catharine of Aragon. In this he failed. He showed policy, however, by promoting the interests of Wolsey as a candidate for the papal throne. He was recalled from Rome to manage the process for the divorce. He was then made secretary of state, and having in the spring of 1531 been further advanced to the archdeaconry of Leicester, was installed Bishop of Winchester in the following November. After some time spent in embassies to France and Germany, he entirely engaged in opposition to such measures as were intended to procure a religious reformation in England. In 1538 he promoted the Act of the Six Articles, and urged its subsequent enforcement. The decline of Cromwell's power tended to the increase of Gardiner's. They had been at the same time in the service of Wolsey, and now stood in direct opposition to each other. After Cromwell's execution in 1540 Gardiner used all possible means to obtain the king's favour, and did not hesitate to aid him in the business of the divorce from Anne of Cleves. Still Henry did not wholly trust him. Cranmer enjoyed the king's friendship, and in consequence, when Gardiner and the Catholic party attempted to convict Cranmer of heresy, the conspiracy signally failed. His next attempt was against Queen Catharine Parr, who favoured the reformers, and had thus offended the vacillating king. But at the very time she was to be arrested she acted with such tact and courage that she completely turned her husband's mind, and from that day Gardiner lost the royal favour. When Edward VI. ascended the throne Gardiner condemned strongly the religious changes then made, which were all in favour of the advancing Reformation. He was accordingly imprisoned in the Fleet Prison, and remained there till the amnesty, which was passed the year after Edward's accession, relieved him. But he was again arrested on account of a sermon preached on St. Peter's Day, 1548, and imprisoned in the Tower. After various conferences, and his refusal to sign the articles submitted to him, he was deprived of his bishopric, and left in prison until Mary came to the throne in 1553. His bishopric was then restored to him, he was made chancellor, and the national affairs were intrusted to his guidance. His power became scarcely less than Wolsey's had been. How it was used in persecution of the reformers is well known. He died on the 12th of November, 1555.

GARE FOWL. See AUK.

GARFIELD, JAMES ABRAM, President of the United States, was born the 19th November, 1831, at a small village called Orange, in the north-eastern part of Cuyahoga County, Ohio—a village at that time of but a few score inhabitants. His father died when young James Abram was but three years old, and his mother, left with two sons and two daughters, passed through extraordinary struggles and privations. She gave her children the best rudimentary education possible under the circumstances, but at an early age they had to leave the village to assist on the farm. James Abram did so at ten years old, but he had imbibed a strong taste for learning, and being gifted with remarkable precocity, his spare time was utilized in the eager prosecution of study. With fair health and a sturdy frame, he could do a man's work at the age of sixteen, and like his great predecessor, Abraham Lincoln, he earned his own living from the very first. His earliest occupation was as driver and then boatman on the Pennsylvania and Ohio Canal. He had a burning passion to go to sea, and canal life had the fascination of being the first step towards nautical adventure. Illness put an end to this employment, and on recovering he was persuaded by his mother to attend the seminary at Geauga, where his education was steadily advanced, and where he learned the Greek and Latin languages. To be able to gratify an insatiable thirst for study by the purchase of some books, he divided his vacation time between teaching children at their homes and earning a few dollars as an extra harvest hand. He afterwards studied under Professor Hopkins at Williams College, where he graduated in 1856. He then became professor of ancient languages and English literature at Hiram College, which was founded by a sect known as Campbellites, or the "Disciples of Christ," who, while they believe in the New Testament, protest against imposing as a condition of church membership any human formula of divine truth. In connection with this body he became popular as a preacher, and engaged in public controversy with a lecturer who sought to overthrow the Bible with the revelations of geology. He was also a very successful teacher, communicating to his pupils some of his own resistless energy, and attracting their warm regard and admiration.

His first appearance in political life was in 1856, when he spoke in favour of General Fremont, the republican candidate for the presidency, and against the democrat candidate, who, however, was subsequently elected. In 1859 he was elected a senator of the state legislature, and here at once headed a party determined to make no fellowship or compromise with slavery on any terms whatever. In 1860 Abraham Lincoln was elected president, in the spring of 1861 the southern states seceded, and in July of the same year the northern volunteers were defeated at Bull Run. A short time afterwards Mr. Garfield raised the 42nd Regiment of Ohio Volunteers, of which he was made colonel and despatched to Eastern Kentucky, where with his own regiment, in conjunction with the 40th Ohio Regiment, he defeated Humphrey Marshall, and thus won the first substantial success in the great war of liberation. He commanded the 20th Brigade under Buell at Shiloh, when the timely arrival of Buell's army enabled Grant to

turn the tide of battle and win an important victory. In 1863, while acting as chief of the staff to General Rosencranz, he organized an intelligence department, or bureau of military information, and persuaded his chief, in spite of the opposition of the seventeen principal officers of the army, to enter upon the very successful Tullahoma campaign. He was promoted to the rank of major-general for gallant and meritorious services at the battle of Chickamauga, in which by his advice the broken fortunes of the day were in great part restored, and the army of the Cumberland saved from destruction. General Garfield had in the meantime been elected to represent his native state in congress, and the cabinet at Washington was at this time sorely in need of men who really knew the requirements of the army. At the urgent request of President Lincoln, therefore, Garfield gave up active service in the field for the duties of his seat in congress, which he continued to hold until raised to the presidential chair.

Upon entering the House he was naturally assigned to the committee of military affairs, and from the chairmanship of this committee he passed in 1869 to the head of the committee on banking and currency. He also did very valuable work in connection with the ninth census (1870), and in 1872 he was promoted to the chair of the committee of appropriations, which superintends the expenditure of the government. He enjoyed the faculty of being always able to express himself in a very able and fluent manner, at all times commanding attention, and often rising to eloquence of no small power. He was frequently called in to aid republican candidates at the hustings by his speeches; and his command of persuasive utterance was also exhibited in the courts, where he held his first important brief as a lawyer in 1868, having studied law during his hours of leisure in the field during the civil war. He strongly upheld the rights of the freed negroes, and resisted every attempt to place them upon a lower level than the white citizens of the republic. On questions of finance he took a resolute stand upon sound commercial principles, and vehemently protested against the delay in returning to specie payments after the war. He considered, however, that to a certain extent protective duties were indispensable in a country like the United States, though professing a great admiration for free-trade doctrines in the abstract. In the forty-fifth congress he was the recognized leader of the republican party, and opposed the democratic majority of the House with remarkable boldness, judgment, and eloquence. After holding this position for two years he was unanimously elected by the republican delegates for Ohio to a seat in the senate; but before taking his place the republican convention was held, and he became a candidate for the presidency, standing against and ultimately defeating the democratic candidate, General Hancock.

General Garfield took office in March, 1881, and at once assumed a bold and independent position on the question of civil service appointments, a field presenting great room for reform. Both General Grant and Mr. Hayes had attempted to oppose the evils of the admittedly corrupt system which prevailed, but had been powerless to provide an effectual remedy. General Garfield achieved something, and gave evidence of his determination in the matter by appointing as collector of customs for New York a person whom he considered most fitting, in opposition to the nominee system. The president, however, lost his life as the penalty of his public spirit; for on the 2nd July he was shot by one Guiteau, a disappointed place-hunter, in the railway station at Washington. After lingering for several weeks in great pain he died on the 20th September, 1881. General Garfield was comparatively a poor man, and £70,000 was at once raised by the people of the United States for the benefit of his widow and family.

GAR-FISH (Old English *gar*, a dart) is the name given to certain fishes, species of the genus Belone, from the fact that they have both jaws produced into a long slender beak. Both jaws are armed with teeth. When these fishes are young the jaws are short; the upper jaw does not lengthen as quickly as the lower jaw, so that during growth the latter is much longer than the upper jaw. The Common Gar-fish (*Belone vulgaris*) is found in abundance on the British coasts, often appearing simultaneously with shoals of mackerels. The flesh has somewhat the flavour of this latter fish, but is not much eaten on account of the green colour of the fish's bones. The gar-fish swims near the surface; it preys on small fishes, seizing them with its long beak. This species is usually about 2 feet long, but other species of the genus attain a length of 5 feet. The head and back are of a dark bluish-green colour; the under surface is silvery white. The pectoral and ventral fins are small. The dorsal fin is close to the tail and opposite the anal; all the dorsal and anal rays are connected by membrane. The caudal fin is forked. The body is covered with small scales. About fifty species of the genus Belone are known from tropical and temperate seas. A few species inhabit rivers. The name gar-pike is also given to this genus, and sometimes to the BONY PIKE (Lepidosteus). The genus Belone belongs to the Scomberesocidæ, a family of Physostomi containing also the FLYING FISH (Exocœtus).

GAR'GANEY. See TEAL.

GAR'GLES are liquids used to produce local effects in the throat and pharynx. The mode of using them consists in taking a small quantity of the gargle into the mouth, allowing it to enter the throat, and then, while holding the head back, agitating the liquid by the expulsion of the breath. With a little care and practice the liquid can be made to descend into the cavity of the pharynx, and even to reach the vocal chords. Gargles are useful in almost all cases of sore throat, seeing that they can be adapted to cleanse and check ulcerations, to check excessive secretion, to act as stimulants to the mucous membrane, and to allay local inflammation.

In putrescent cases gargles composed of permanganate of potash (2 drachms of the solution to half a pint of liquid) are very useful, and chlorinated soda or sulphurous acid is also valuable. Where astringents are required the alum gargle (alum 2½ drachms, honey 1 ounce, rose water 1 pint), or that of borax (borax 5 drachms, water 1 pint), may be tried; while an excellent stimulating gargle can be made by adding 100 minims of the tincture of capsicum and 50 minims of dilute acetic acid to half a pint of water.

GAR'GOYLE, in Gothic architecture, a spout which is carried out from parapets in order to discharge the water from roofs clear of the wall. Mediæval architects, instead of having plain projecting pipes for their spouts, covered the pipe with a block of stone, and carved it into a grotesque character. Angelic, human, and brute forms were made, and the water generally spouted through the mouth; occasionally in classical architecture masks of human faces replace the usual lions' heads. Gargoyles appear to have been first generally used in the Early English style, and they were most prominent in that and the Decorated. The use of stack pipes to convey away the water has superseded the use of gargoyles, which now remain merely as ornaments or parts of a style or characteristic design.

GARHWAL or **TEHRI,** a native state in political relationship with the government of the North-western Provinces, British India. It extends over the south-western declivity of the Himalayas, and consists throughout of a vast range of mountains of enormous height, intermingled with several valleys, the drainage of the whole ultimately finding its way to the Ganges. The chief town is Tehri, by which appellation the state is sometimes known. During the mutiny of 1857 the rajah rendered valuable

assistance to the government. He died in 1859 without legitimate issue, and in accordance with the terms of the treaty the state lapsed to the British government; but in consideration of the services of Sudar Shan Sah, his eldest illegitimate son, Bhawari Sinh, was allowed to succeed. The rajah pays no tribute.

GARIBAL'DI, GIUSEPPE, one of the greatest heroes of modern times, and who, with Victor Emmanuel and Count Cavour, succeeded in making Italy an independent kingdom. The history of the half-educated sailor who, by no aid but that of simple superiority of character, collected to his side a band of followers so devoted to him that no service could be too dangerous or too painful for them to undertake if he ordered it; who, surrounded but by a few followers or even single-handed, and armed only with a cavalry sword, many times stood his ground against incredible odds; who, with a small force of irregular levies, chased an ancient dynasty, backed up with fleets, fortresses, and armies, from its kingdom; and who, though a republican, forgetful of himself in his love of his country at the high tide of success, handed over his conquest to his hereditary prince, and retired quietly to his farm in a barren island in the Mediterranean—seems more like a romance of the middle ages than a sober history of a soldier of the nineteenth century. But perhaps the most difficult part of the tale to understand is that which describes the man as absolutely free from selfish ambition, fearless to a fault, yet gifted with a most loving and gentle heart, and without the least taint of vindictive passion. Such a man was Garibaldi, and throughout his whole career, whatever follies or even crimes may have been committed in his name, not a single act of meanness or deed of cruelty can be traced to the patriot himself. He was born at Nice, 22nd July, 1807, in the very room in which Massena, that *enfant gâté de la victoire*, first saw the light forty-nine years before. Though his mother, for whom he had a sincere affection, wished him to be a priest, his affections were fixed on the sea, and in early life he embarked in his father's merchant vessel, and in that and other craft made frequent voyages to Odessa, Rome, and Constantinople.

Coming under Mazzini's influence soon after the revolutionary movement of 1831, and being compromised in a plot at Genoa, he was obliged to go into exile, and at last found his way to Rio Janeiro. Here he gained his first practical experience of war, for he took service with the republic of Rio Grando do Sul against Brazil, and passed through some of the most romantic and extraordinary episodes of his life. It was at this period that he married Anita, who ever after was his faithful companion in all his campaigns, until she died from the hardships of the disastrous retreat from Rome in 1849. His sword was next drawn in the cause of the republic of Uruguay, when under his command the Italian legion rose to high distinction.

In 1847 Europe was in a state of revolutionary disturbance, and the pope seemed to be on the verge of war with Austria. Garibaldi offered his services to the pontiff, but receiving no definite reply embarked for Europe. In conjunction with Mazzini he attempted to carry on the war against Austria after Charles Albert had been compelled to conclude an armistice in August, 1848, but this action did not meet with success. A few months later he engaged in the defence of Rome against the French, but after holding out for three months was obliged to retreat, and having failed to reach Venice, which still held out against the enemy, and undergoing terrible hardships, he surrendered to the Sardinian Carboniori, and though treated with all honour had once more to go into exile. Having crossed the ocean, he settled at New York as a tallow-chandler, and only came back to Europe in 1855. Up to the close of this first dolorous episode of 1848–49, Garibaldi had shown himself a patriot rather than a partisan. His first application was to a pope, and he had evinced no enmity to kingship.

On his return he settled on a small farm he had purchased on the island rock of Caprera, and here he remained until 1859, when France and Piedmont took the field against Austria. Garibaldi took the oath of fealty to Victor Emmanuel, and having received the command of the Chasseurs des Alpes, materially aided in carrying out the plan of the campaign.

The year 1860 marked the climax of Garibaldi's success, and his character was exhibited in its noblest aspect. Followed by a small band he attacked the kingdom of the Two Sicilies, and rousing the country as he went, drove the royal armies from place to place until he found himself dictator in the capital. The enthusiasm of his followers was almost unexampled; but without taking advantage of it to secure any personal position or benefit whatever he gave over his conquest to Victor Emmanuel as the king of a United Italy, and surrendered his heart's desire in giving up the march on Rome. Then refusing all honours, he quietly retired to the solitudes of Caprera. In the letter announcing his departure on this expedition to Victor Emmanuel, the concluding remarks strikingly illustrate his feeling towards the king. He writes, "I have not acquainted your Majesty with my project; I feared, in fact, that with the reverence I feel towards you, you would have succeeded in persuading me to abandon it."

Elected deputy to the chamber, he took his seat in order to use his influence against the cession of Nice to France, and to advocate the claims of his followers as soldiers in the Italian army. He appeared dressed in his famous red shirt and gray trousers, over which hung the folds of the Spanish-American *poncho*, an ample upper garment of thin white woollen cloth with crimson lining, and was received enthusiastically. But the blunt soldier was little suited to such an assembly, and after a fierce quarrel with Cavour he withdrew to Caprera.

Urged on by unwise counsels in 1862, Garibaldi made a rush for Rome that ended in his seizure by the Italian troops at Aspromonte, when he was wounded, and a slight collision occurred, owing, as the hero simply acknowledged, to an unusual want of decision on his part. In 1864 he visited England, and two years later took the field again for a short time against Austria. In 1867 the Italians had the humiliation of seeing their favourite defeated at Mentana by a combined papal and French force, when he had been induced to make another attempt on Rome by the manœuvres of Ratazzi. His last appearance in active warfare was in the service of the French republic in 1870, where, though showing much ability, he did not gain much credit or gratitude. Rome had meantime become the capital of Italy, and in 1874 he again took his seat in the Italian Parliament, but confined his attention to works of public utility. He ardently advocated a new canal for the Tiber, which would have effectually drained Rome and prevented the still not unfrequent inundations, and would have uncovered the present bed of the river, in which countless treasures of antiquity are known to lie. Five years later he visited Rome to lend the influence of his great name to the cause of the *Italia Irredenta*, but his common sense and his increasing infirmities soon led him to silently withdraw himself from the agitation. He died at Caprera, 2nd June, 1882, aged seventy-four.

As a general Garibaldi had little power of organization, but on the field of battle he was an able tactician, and would have creditably handled an army had a ready-made one, well-armed and trained and led, been placed under his orders. He had a sure glance, quick resolution, and prompt resource. An interesting life of Garibaldi by Giuseppe Guerzoni, one of his intimate followers, was published at Florence in 1882.

GAR'LIC, a hardy perennial plant with bulbous roots. De Candolle, in "L'Origine des Plantes Cultivées, 1883," comes to the conclusion that this plant was in ancient

times found wild in Western Asia and Europe, from Tartary to Spain; although at the present day it is doubtful whether it occurs truly wild anywhere but in Kirghis and Songaria, in the south-west of Siberia. In gardens it is cultivated chiefly on account of its bulbs, which are much used in cookery, and occasionally in medicine.

Garlic is the *Allium sativum* of botanists, and is regularly grown for the market. [See ALLIUM.] For this purpose, a light tolerably rich soil is selected in a dry warm situation. The ground should be well dunged for the crop which precedes garlic, and not when the garlic is planted, because when this is done the bulbs are very apt to canker and to be infested with maggots. The plant is propagated by offshoots, which it produces annually in considerable numbers, and which are commonly called cloves. The season of ripeness, which is generally in the end of July or August, is easily known by the leaves changing from green to yellow. At this period the bulbs should be taken up and spread out in the sun to dry, after which they may be tied in bunches and kept in a dry house for winter use, in the same way as onions.

GARNET, HENRY, the son of a schoolmaster at Nottingham, was born about 1554, and educated as a Protestant at Winchester College. He next became a corrector of the press in London. Having turned Roman Catholic, he entered the Society of the Jesuits, and studied in their college at Rome with such distinction that in 1586 he was appointed to the English mission, and in 1588 made provincial of the English Jesuits. Before the death of Queen Elizabeth he had engaged in treasonable intrigues with the King of Spain, and to protect himself purchased a pardon on the accession of James I. In September, 1605, he undertook a pilgrimage to St. Winifred's Well, in Flintshire, and with him were some of the persons who were seized two months later, at the dispersal of the famous "hunting party," as conspirators in the Gunpowder Plot. Garnet and another Jesuit, Oldcorne, were arrested at Hendlip Hall, near Worcester, in one of the secret hiding-places with which that mansion abounded, and were conveyed to the Tower of London. Oldcorne was tortured; Garnet and he were brought secretly and treacherously together, and their conversation reported; and in the end they were tried, found guilty, and executed. Garnet was hanged in May, 1606, in the city of London. He took no part in the plot, though he kept the secret guiltily. Both were considered martyrs by the Catholic Church.

GAR'NET-ROCK is a peculiar variety of a metamorphic rock, almost exclusively composed of garnet (alumina or iron lime variety in general) associated with hornblende; it is usually a tough rock of a yellowish-white or greenish-white colour, in which epidote and calcite occur as accessory minerals. When smaragdite is present the rock passes into *eklogite.* Some other rocks in which garnets are important constituents are *eulysite*, where they are associated with augite; and *kinzigite*, where they are associated with mica and oligoclase. As a general rule felspars do not occur in garnet-rocks.

GAR'NETS are a group of isomorphous silicates, all crystallizing in the isometric system, most usually as rhombic dodecahedra or as icositetrahedra, and having as bases either sesquioxides of iron, alumina, chromium, or manganese; or protoxides of iron, lime, magnesia, and manganese. Their hardness ranges from 6·5 to 7·5, and their specific gravity from 3·1 to 4·3.

The chief divisions, according to the dominant base, are—1, *alumina-garnets*, including almandine or precious garnet, GROSSULARITE, pyrope, spessartite, &c.; 2, *iron-garnets*, as andradite, COLOPHONITE, aplome, &c.; 3, *chrome-garnets*, as ouvarovite.

Garnets occur in crystalline limestone and dolomite, gneiss, schist, granite, and some other varieties of intrusive and metamorphic rocks.

The name garnet appears to be derived from Lat. *granatus*, grain-like, from the general rounded form, or possibly from *granatus*, in allusion to the red colour like the seeds of the pomegranate.

The *carbuncle* of the ancients was probably a garnet, as also possibly the *hyacinth.* Garnets free from flaws and of a good colour are of some value as gems, while pulverized garnets are used for the same purposes as emery.

GARO'FALO, the name by which Benvenuto Tisio is commonly known, apparently from his adoption of a gilliflower (*garofalo*) for his monogram. He was born in the Ferrarese in 1481, and was first instructed in design by Domenico Panetti, from whom he went to his uncle, Nicolo Soriano, at Cremona. In 1508 he engaged himself with Raphael in Rome, where he spent some years, assisting the master in his work at the Vatican. Garofalo, though the most distinguished of the Ferrarese painters, belongs to the Roman school. For Raphael he had an enthusiastic veneration, and made him his exemplar. Four of his small pictures are in the National Gallery at London. The best is a Madonna and Child, formerly an altar-piece in San Guglielmo, Ferrara. In some points of colour he excelled his master, but his execution is dry, and as a whole his pictures want harmony. His best work is the "Apparition of the Virgin to St. Bruno" at Dresden. He died in Ferrara in 1559, having been for the last nine years of his life quite blind.

GARONNE (the ancient *Garumna*), a river in the south-west of France, which rises in the Val d'Aran, near the foot of Mount Maladetta, in the Spanish Pyrenees, and enters France at a place called Pont du Roi, in the department of Haute Garonne. From this point it runs N. past St. Béat to Montrejeau, where it is joined on the left bank by the Neste; its course is then easterly as far as St. Martory, where the Salat enters it on the right bank. Hence turning N.E. it passes Cazères, where it becomes navigable; between this place and Toulouse it receives the Louge on the left bank; the Volp, the Arize, and the Ariège, on the right. At Toulouse it is joined by the Canal du Midi, and turns N.W., in which direction it continues generally to its mouth, passing Verdun, Agen, St. Macaire, and Bordeaux, a few miles below which, at Bec d'Ambès, it enters the estuary of the Gironde. Its principal feeders below Toulouse are the Gironde, the Tarn, the Lot, and the Dropt, on the right bank; the Save, the Gimone, the Gerse, the Baise, the Avance, and the Ciron, on the left.

The length of the Garonne is about 352 miles, of which 262 are navigable; it communicates either directly or by its navigable feeders with twelve departments, the total river navigation of its basin being about 1000 miles. The tide ascends to St. Macaire, and vessels of the largest size go up as far as Bordeaux. By this river and the Canal du Midi the Bay of Biscay is united to the Mediterranean.

The basin of the Garonne is bounded S. by the Pyrenees, E. by the Cévennes, N. by the Auvergne Mountains and their western offshoots, and W. by ramifications of the Pyrenees, which extend to the mouth of the Gironde. Its length from S.W. to N.E. is about 200 miles, its breadth about the same; in its lower part, however, the basin (including therein the Gironde) does not exceed 25 miles in width. The valley of this river is remarkable for the richness of its products, and for the beauty of its scenery.

At Bec d'Ambès, near the confluence with the Dordogne, the river widens out and becomes the Gironde, which runs N.W. and connects those rivers with the Bay of Biscay. From Bec d'Ambès to its mouth the channel of the Gironde presents a succession of islets and banks, which nearly divide it into two equal branches, and render the navigation somewhat intricate. Its length is about 40 miles; its breadth at Bec d'Ambès is about $1\frac{3}{4}$; its greatest width is 7 miles; at its entrance into the Bay of Biscay the breadth is scarcely 3 miles. Its shores below Blaye are

uninviting, and present to view only bare rocks and dreary heaths. This estuary is subject to the *mascaret* or bore. [See BORE.] The crest of the bore rises from 13 to 16 feet above the surface of the river; and this great mass of water, moving along with impetuous velocity, often causes serious damage to vessels exposed to its violence, not only in the Gironde but also in the Dordogne, which river it ascends for about 20 miles.

GARONNE, HAUTE, a department in the south of France, formed out of a portion of Haut Languedoc and that part of Gascogne called Comminges, is bounded N. by the department of Tarn-et-Garonne; N.E. and E. by those of Tarn, Aude, and Ariège; S. by the Pyrenees, and W. by the departments of Hautes Pyrénées and Gers. Its greatest length, from N.E. to S.W., is 100 miles; its greatest breadth is 63 miles. The area is 2428 square miles, and the population in 1881 was 478,009.

The south of the department is covered with lofty mountains, belonging to the principal range or branches of the Pyrenees, the peaks of which rise in many places in this department, or just close to it, to a height of from 9000 to 11,800 feet. The last number expresses the height of Mont Maladetta, from the snows of which the Garonne springs. The lower slopes are covered with thick forests of oak, pine, fir, &c., or are occupied as sheep-walks or pasture-grounds. The mountains are diversified by beautiful lakes and cascades, and intersected by lovely valleys, such as that of Luchon. The lake and cascade of Oo, at the extremity of the valley of Larboust, are among the finest sights in the Pyrenees; the cascade, which is broken about midway in its descent, has a total fall of 1600 feet. The scenery higher up the mountains is of the most savage description, and large glaciers are met with. The communication with Spain is kept up through depressions in the mountains, here called *ports*. The Port d'Oo, the loftiest pass in the Pyrenees, is 9850 feet high. The north of the department is occupied by hills of moderate elevation, separated by extensive and very fertile plains.

The department belongs entirely to the basin of the upper Garonne, from which river it takes its name, and which traverses it from south to north. Of the other rivers, the principal are the Neste, the Salet, the Ariège, the Lers, the Louge, the Touch, the Save, the Gimone, and the Tarn, all feeders of the Garonne. The department is traversed by the Canal du Midi, the railway from Bordeaux to Cette and its branches, and by seven governmental and thirty-two departmental roads.

The mineral treasures of the department are iron, copper, lead, antimony, bismuth, zinc, coal, rock-crystal, slates, gypsum, marble, jet, and granite. Gold has been found in the sands of the Garonne and the Salet, and good white and other marbles are quarried to some extent at St. Beat. There is a salt-spring at Salies. Mineral waters are found at various places; those of Bagnères-de-Luchon are the most celebrated.

In the higher parts of the mountains the winters are severe and long; in the hills and plains, which make up the greater part of the department, the climate is mild; it rarely freezes, and a fall of snow is almost unknown. The average number of rainy days in the year is about 100; the rest of the year is dry, and almost equally divided between bright sunny and cloudy weather. The east and west winds predominate; the latter bring cold and rain. Tempests are frequent and violent. Goitres are common among the mountaineers.

In the mountainous tracts it is only by dint of industry that any returns can be procured by the farmer. The valleys are very productive. The most fertile localities are the plain of Toulouse, the productiveness of which is noticed by Julius Cæsar, the valley of the Garonne generally, and the neighbourhood of Rieux, in the valley of the Ariège, where two harvests are obtained in the year.

The arable land is well adapted to the cultivation of wheat, maize, buckwheat, millet, rye, and other grains and pulse. A great deal of garlic is grown; flax, hemp, potatoes, chestnuts, tobacco, truffles, melons, orange flowers, fruit trees, and medicinal plants are also produced. The quality of the wine is generally inferior. The uplands and the valleys furnish abundance of excellent pasture; the mountains abound with wood suited for shipbuilding. Many oxen are bred in the extensive pastures of this department; asses, mules, sheep, and swine are numerous. Poultry is abundant. The geese and ducks are plentiful, and of great size; numbers of them are salted for household use and for exportation. A little honey and silk are produced. In the mountains there are the wild boar, the roebuck, the wolf, the fox, the heathcock, and different varieties of the eagle. The partridge, ortolan, and quail are taken in abundance in the plains. The rivers and lakes abound with fish.

The commerce of the department is composed of the products already named, and of its manufactures, the chief of which are scythes, files, copper utensils, mathematical instruments, porcelain, pottery, tiles, coarse woollens, canvas, blankets, calico, tape, straw-hats, brandy, tin-ware, and leather of various kinds. There are iron furnaces, and factories of different kinds, including glass-works, copper foundries, cannon foundries, gunpowder mills, tobacco factories, distilleries, marble-sawing works, &c., and wind and water mills. The department has considerable commercial intercourse with Spain, whither many handicraftsmen annually emigrate.

The department is divided into four arrondissements—Toulouse, Villefranche, Muret, and St. Gaudens. The capital is Toulouse.

GAROTTE, a Spanish mode of inflicting the punishment of death by means of a collar tightly screwed round the neck, while the criminal is fastened to an upright board to which the collar is attached. The term is also applied in this country to the modes of strangulation adopted by thieves and footpads for the purposes of robbery.

GARRICK, DAVID, a celebrated actor, descended from a French Protestant family of the name of Garrique, was born 20th February, 1716, at Hereford. His father was a captain in the army, his mother the daughter of a vicar of Lichfield Cathedral. At the age of eleven he performed Sergeant Kite in Farquhar's comedy of the "Recruiting Officer." He was first educated at the grammar-school of Lichfield; subsequently, in 1735, he became the pupil of Samuel Johnson. With him, in 1736, Garrick came to London, where he entered the Society of Lincoln's Inn. On the death of his father he commenced business with his brother Peter as wine merchant; the partnership, however, was soon dissolved. In 1741 David Garrick finally resolved to adopt the profession towards which his desires had so long tended; he then made his first appearance on the stage at Ipswich, under the name of Lyddal. The character chosen was Aboan, in the tragedy of "Oroonoka." His success was decided, and in all departments—tragedy, comedy, and even pantomime, in which he played harlequin. The manager was then proprietor of the theatre in Goodman's Fields, London, and there Garrick made his first metropolitan attempt in Richard III., on the 19th of October, 1741. Before many weeks elapsed, the chief theatres were deserted, and persons of all conditions were flocking to see the new actor. He performed three nights at the close of the season at Drury Lane in 1742. He then went to Dublin, where his reception was enthusiastic. In 1745 he joined Mr. Sheridan in the management of the Theatro Royal, Dublin. On the 15th of September, 1747, he opened the Covent Garden Theatre, London, as joint patentee with Mr. Lacy, and spoke the well-known pro-

logue by Dr. Johnson. On the 22nd of June, 1749, he married Eva-Maria Veigal, the daughter of a citizen of Vienna. She had first appeared at Drury Lane as a dancer in 1746. On the 7th of September, 1769, Garrick carried out his long-cherished scheme of a Shakspeare Jubilee at Stratford-on-Avon. After twenty-seven years of active management at Drury Lane, having secured an ample fortune, he took his leave of the stage on 10th June, 1776, in the character of Don Felix, in "The Wonder," the performance being for the benefit of the fund for decayed actors. In 1777 he was put into the commission of the peace. He died at his own house in the Adelphi, 20th January, 1779, and was buried with great pomp in Westminster Abbey, close to Shakspeare's monument. As an actor, Pope's words to Lord Orrery sum up all that need be said—"That young man never had his equal as an actor, and never will." As a literary man he also exhibited some ability. He wrote verses, prologues, and epilogues, altered and adapted many plays, and wrote some original works. Of the last, his farce of "The Lying Valet," and his share with Colman in "The Clandestine Marriage," are well known. Mrs. Garrick, who enjoyed a great reputation as a conversationalist, died at the age of ninety-eight, on the 16th of October, 1822, being then in the full possession of her faculties.

GAR'RYA, a genus of plants belonging to the order CORNACEÆ. It is nearly allied to the well known Aucuba; there are no petals, and the ovary has two ovules. The genus was named by Douglas in compliment to Nicholas Garry, secretary to the Hudson Bay Company. The species are shrubs, natives of California, Mexico, and West Indies. Two species of this genus have been introduced into Great Britain; they are very ornamental, and grow best in a loamy soil, and may be propagated by layers.

Garry elliptica (the elliptic-leaved Garrya) has, when young, soft, pubescent, and purplish branches; when older they become smooth and grayish. When in bloom this shrub presents a striking and beautiful appearance, with its delicate pendulous catkins, which are from 8 inches to a foot in length. The flowers appear in the early spring; they are greenish-yellow, the male and female on different plants. It is easily cultivated in our gardens, and is as hardy as the common Lauristinus. *Garrya laurifolia* is an evergreen shrub or low tree, and grows on the mountains of Mexico.

GARTER, ORDER OF THE, one of the most ancient and illustrious of the military orders of knighthood in Europe, was founded by King Edward III. in 1350, according to Stowe. The story of the Countess of Salisbury dropping her garter at a ball, the picking it up by the king, and his word in reproof to the smiling courtiers, *Honi soit qui mal y pense*, which afterwards became the motto of the order, are well known; but the legend is doubtful.

The order was founded in honour of the Holy Trinity, the Virgin Mary, St. George (the tutelar saint of England, its especial patron), and St. Edward the Confessor. It originally consisted of the king and twenty-five knights named by him. George III. increased the number by directing that princes of the royal family and illustrious foreigners should be considered as additional to the twenty-five. The Military Knights of Windsor are also considered an adjunct of the order. Its officers are—the prelate, the Bishop of Winchester; the chancellor, the Bishop of Oxford; the registrar, the Dean of Windsor; Garter Principal King-at-Arms; and the Usher of the Black Rod. Installation of new members takes place in St. George's Chapel, Windsor, in which the banners of the several knights are suspended. The costume now consists chiefly of a mantle of dark blue velvet, hood of crimson velvet, cap with an ostrich and heron plume, stockings of white silk, and garter on the left knee, of dark blue velvet, with the motto in gold letters. A gold medallion of St. George and the Dragon, suspended by a blue ribbon, is worn as a badge, and a broad blue ribbon is worn transversely across the breast; hence the phrase that a man has received the blue ribbon is frequently used to express an appointment as knight of the Garter. A star is also worn on the left breast. Ladies were members of the fraternity so late as the reign of Edward IV. The fame of the *blue ribbon* of the Garter is so great that the phrase is used as expressing the highest dignity or honour attainable in any pursuit, from the "blue ribbon of the turf" (victory at "the Derby") to the "blue ribbon of art" (the presidency of the Royal Academy), &c.

GARTH, SIR SAMUEL, M.D., author of the famous mock heroic poem called the "Dispensary," was born in Yorkshire in 1660, and died in 1719. He was a hard-working physician, and was knighted by George I. in this capacity. The plot of the poem is, of course, of secondary importance. It turns upon a quarrel among the members of the College of Physicians, who, though they gave advice gratis to the poor, yet compelled them to pay dispensary charges for medicines. A society to provide medicines at cost price to the poor was started, and the inevitable contests over it gave Garth his subject. The treatment is exceedingly clever, probably quite equal to Boileau's similar "Lutrin." The "Dispensary" was published in 1699. It is almost needless to say that Garth, a very kind-hearted man, wrote almost as much for the cause of benevolence as for fame. He is happy enough to have attained both objects.

GAS. This simple term was first introduced in 1600 by a Dutch chemist, Van Helmont, to express the aeriform condition of matter. This chemist was the first to study other gases as having properties different from atmospheric air, and to distinguish between permanent gases and condensable vapours. Before his time the alchemists appear to have considered all gases to be modified or impure atmospheric air. A gas is now recognized as a form of matter, having perfect elasticity, and under constant pressure a uniform rate of expansion for equal increments of temperature, this expansion being indefinite; that is to say, that any space will be filled by any quantity of a gas, however minute the proportion may be. A vapour was originally held to differ from a gas in being easily condensed to a liquid. All known gases have, however, now been liquefied under great pressure and a very low temperature. Under these circumstances a gas resembles a vapour, and at very high temperatures a vapour closely resembles a gas. Atmospheric air, a mixture of oxygen and nitrogen, is the most important and the best known gas. The oxygen in air was first discovered by Priestley in 1774. He subsequently discovered hydrochloric acid, ammonia, fluosilicic, nitrous oxide, and sulphurous acid gases. In 1781 Cavendish discovered hydrogen, and showed that water was a compound of this gas and oxygen. The relations by volume in the combination of gases was first pointed out by Gay-Lussac and Humboldt in 1805. In 1818 Gay-Lussac propounded the theory that the combining volumes of the gaseous elements bear a simple ratio to their atomic weights. Taking a given volume of hydrogen as 1, the weight of the same volume of nitrogen is 14·01, oxygen 15·96, chlorine 35·37, these numbers representing the true atomic weights or combining equivalents of the elements.

Some gases are extremely soluble in water, as, for example, hydrochloric acid gas and ammonia gas. Of the latter gas water absorbs 670 times its volume, or half its weight.

Certain porous substances absorb large quantities of some gases; wood charcoal is an instance of this—it absorbs ninety times its volume of ammonia, and nearly as much of several other gases. Many metals take up a large amount of some gases. Aerolites always contain gas, and palladium absorbs 935 times its volume of hydrogen at a red heat.

The lighter gases, such as hydrogen, light carburetted hydrogen, and ammonia, diffuse with great rapidity even through very minute orifices, also through membranes, as bladder or caoutchouc, and through porous bodies, such as gypsum, artificial graphite, or unglazed earthenware; the passage of hydrogen through any of these bodies is extremely rapid. Air passes in large quantity through the thickest walls built of stone, of brick, or of earth, and this affords a constant system of aerial ventilation of great importance in our dwelling-houses. When the walls are saturated with moisture this healthy action is arrested. Light carburetted hydrogen or marsh gas is found in our sewers, and accounts partly for the rapid diffusibility of sewer gases.

The properties of the so-called permanent gases will be noticed under their respective names. All have now been reduced to liquids, and many to solids, so that all have been proved to be condensable. Gases differ much in density. Hydrogen is much lighter than air, while carbonic acid is so much heavier that it can be poured from one vessel to the other. The most important gases are oxygen, the supporter of life and combustion; hydrogen, the base of water; and carbonic acid, the result of oxidation; and that mixture of gases so largely used for heating and illumination under the name of coal-gas.

GAS ENGINE. Successful attempts have recently been made to utilize, as a motive power, the expansive force arising from a mixture of common coal-gas and air. The engine employed is somewhat similar to an ordinary horizontal steam-engine, and air and gas are made to flow into the cylinder in the proportions of 11 of the former to 1 of the latter, until it is nearly half full, when an explosion is caused by a spark from a galvanic battery. This explosion sets the piston in motion, and in returning to its former position it sucks in another supply of gas and air, which explodes at the proper moment, and thus keeps the engine in continual motion. Notwithstanding their cost—for they are more expensive than an ordinary engine and boiler of the same size—these engines have come into very general use, especially in France, where they are employed in nearly everything in which a power of only two or three horses is required. An engine of two-horse power costs from 24*s.* to 30*s.* per week for gas, if kept continuously employed; but as it requires no stoker it is found in the end to be much more economical than a steam-engine—provided, as we have before said, not more than two or three horse-power is required.

GAS LIGHTING. Gas suitable for the purposes of illumination may be made from several organic substances—coal, oil, and wood being the most suitable. In practice it is most generally made from coal.

When coal is subjected to the action of heat it gives off large quantities of dense smoke, which, if the temperature is sufficiently high, burns with a bright flame; this is coal-gas in its crude condition. The idea of collecting this smoke or gas and conveying it in pipes, so that it might be used for the purpose of illumination, had occurred to several investigators; but the merit of first practically applying gas to this purpose is due, without doubt, to William Murdoch, a native of Old Cumnock, in Ayrshire, who, while residing at Redruth, in Cornwall, about the year 1792, made a number of experiments on the gases obtained from various organic substances, with the object of ascertaining their suitability for the purposes of illumination and the cost of the light as compared with that given by oils and tallow. He continued his investigations until 1797, when, on his return to Ayrshire, he lighted up his premises with gas; and in the following year, while he was engaged in the manufacture of steam engines with Messrs. Boulton & Watt, he constructed a gas apparatus and lit up the principal building of that firm's works at Soho, in Birmingham, on many successive nights. The first public exhibition of the new light was on the occasion of the peace of Amiens, in 1802, when the whole front of Messrs. Boulton & Watt's factory was illuminated. A writer at that period thus describes the effect of this illumination:—"The whole front of the extensive range of buildings was ornamented with a great variety of devices that admirably displayed many of the varied forms of which gas light is susceptible. The luminous spectacle was as novel as it was astonishing, and Birmingham poured forth its numerous population to gaze at it."

The works of Messrs. Boulton & Watt continued to be lighted with gas to the exclusion of other artificial light, and from this period the manufacture of illuminating gas continued to extend. In 1805 Pall Mall was lit by gas; and in 1812 a charter was granted to the first public company, authorizing them to manufacture and supply gas in a district of London. The formation of other companies soon followed, and now the quantity of gas manufactured in London alone exceeds 20,000,000,000 cubic feet per annum, manufactured out of 2,000,000 tons of coal, and distributed through 2500 miles of pipes, from 3 inches to 4 feet in diameter; the cost of the gas sold being about £3,000,000.

The coals most suitable for the production of gas are the bituminous caking coals, found principally in the neighbourhood of Newcastle-upon-Tyne, and the cannel coal, found in several parts of England, and more extensively and in greater variety in Scotland. Caking coal is soft and friable, has an irregular fracture, and derives its name from the circumstance that when heated its fragments fuse together, forming an excellent coke. The average yield of gas from this coal is about 10,000 cubic feet per ton, having an illuminating power of about sixteen candles.

Cannel coal derives its name most probably from having been used at one time in cotters' houses to give light instead of candles. There are many varieties of cannel coal; some kinds, such as that got in the neighbourhood of Wigan, give a gas of not much over twenty candles, with a good coke. Others, such as Boghead, yield a large quantity of gas, having an illuminating power of about forty candles, with a coke which is quite worthless. There are many varieties between these two. Generally cannel coal may be described as having a hard smooth texture, with a shining surface, and breaking with a fracture more or less conchoidal; and the residual coke is, in almost all varieties, much inferior to that derived from caking coals. There are many other varieties of coal suitable for gas-making found in different parts of the world. It would, however, be quite beyond the limits of this article to enter into a description of these. But they all more or less resemble in character either the caking or the cannel coal above described.

The general principles of gas-making are not difficult to explain. A quantity of coal is put into a vessel called a retort, which is entirely closed, with the exception of an outlet pipe. This retort is maintained at a bright-red heat by means of a fire placed beneath it. The heat drives off the gas in the form of a dense smoke. This passes by the outlet pipe into a condenser, where it is cooled and the tarry matter deposited; it then passes into a washer or scrubber, where it is washed with water, which removes any remaining tarry particles and the ammonia; from the scrubber it passes to a vessel filled with lime or oxide of iron, or both, which removes the carbonic acid and the sulphur impurities. It is then stored in a gasholder ready for use. This description will be more readily followed by looking at fig. 1, which represents a small apparatus suitable for lighting a country house of moderate dimensions, where R represents the retort, F the fire, B the outlet-pipe, C the condenser, S the scrubber, P the purifier, and D the gasholder. In larger works certain modifications and

additions are required, which will be afterwards described, but the cut represents all that is absolutely essential to the process of gas-making.

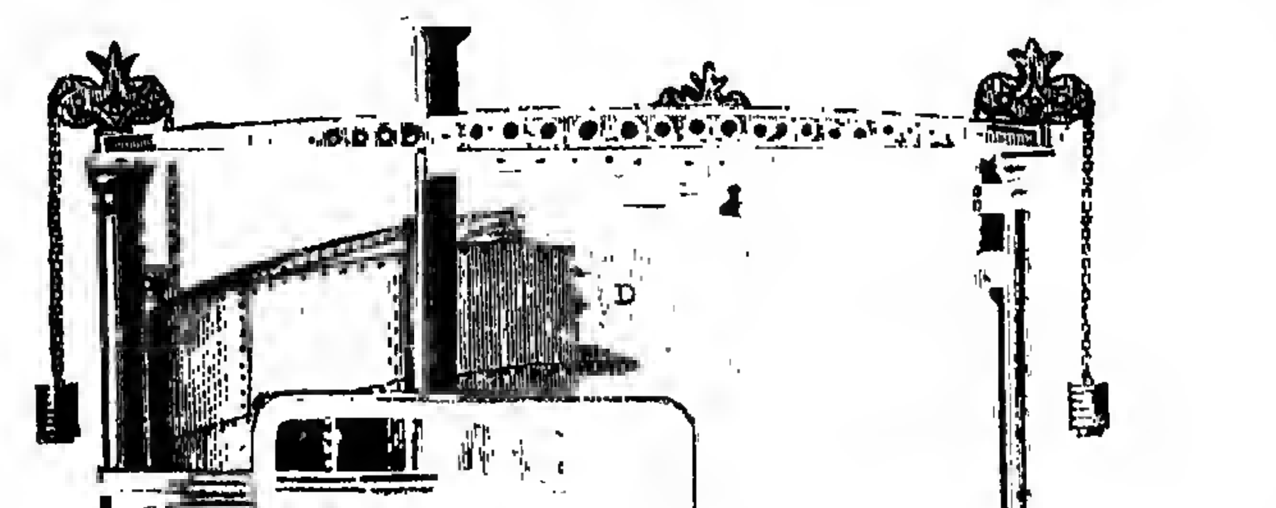
The chemical composition of coal-gas varies not only with the quality of the coal used, but is also affected by the temperature of the retorts and other conditions of carbonization. The following is an analysis of gas made from Newcastle coal, according to Dr. Frankland:—

Olefiant gas,	3·53
Marsh gas,	35·25
Hydrogen gas,	51·81
Carbonic oxide,	8·95
Nitrogen,	0·38
Oxygen,	0·08
	100·00

Coal-gas as it leaves the retorts contains, besides these constituents, many impurities; the principal of which are tar, water, ammonia, carbonic acid, sulphuretted hydrogen, and other compounds of sulphur. The methods employed to remove these have already been indicated, and will be afterwards more fully explained. When all the gas has been driven off the coal there remains in the retort a quantity of coke, amounting to from 60 to 70 per cent. of the weight of coal used, consisting mostly of solid carbon, with a quantity of ash varying from 2 to 20 per cent., according to the quality of coal used.

We will now describe more particularly the apparatus employed in the manufacture of gas in a modern work of average dimensions. The retorts now employed in all gas-works are made of fire-clay. They are of various shapes and sizes. The most common is the ⌓-shaped, about 20 inches wide and 14 inches high, and from 9 to 10 feet long, the fire-clay being from 2½ to 3 inches thick. Bolted to the front of the retort, and projecting beyond the brick-work, is a cast-iron mouth-piece, to which the retort lid and outlet pipe are attached. The retorts are set in beds or ovens, each oven containing from seven to nine retorts; the furnace being placed in the lower part of the oven, as

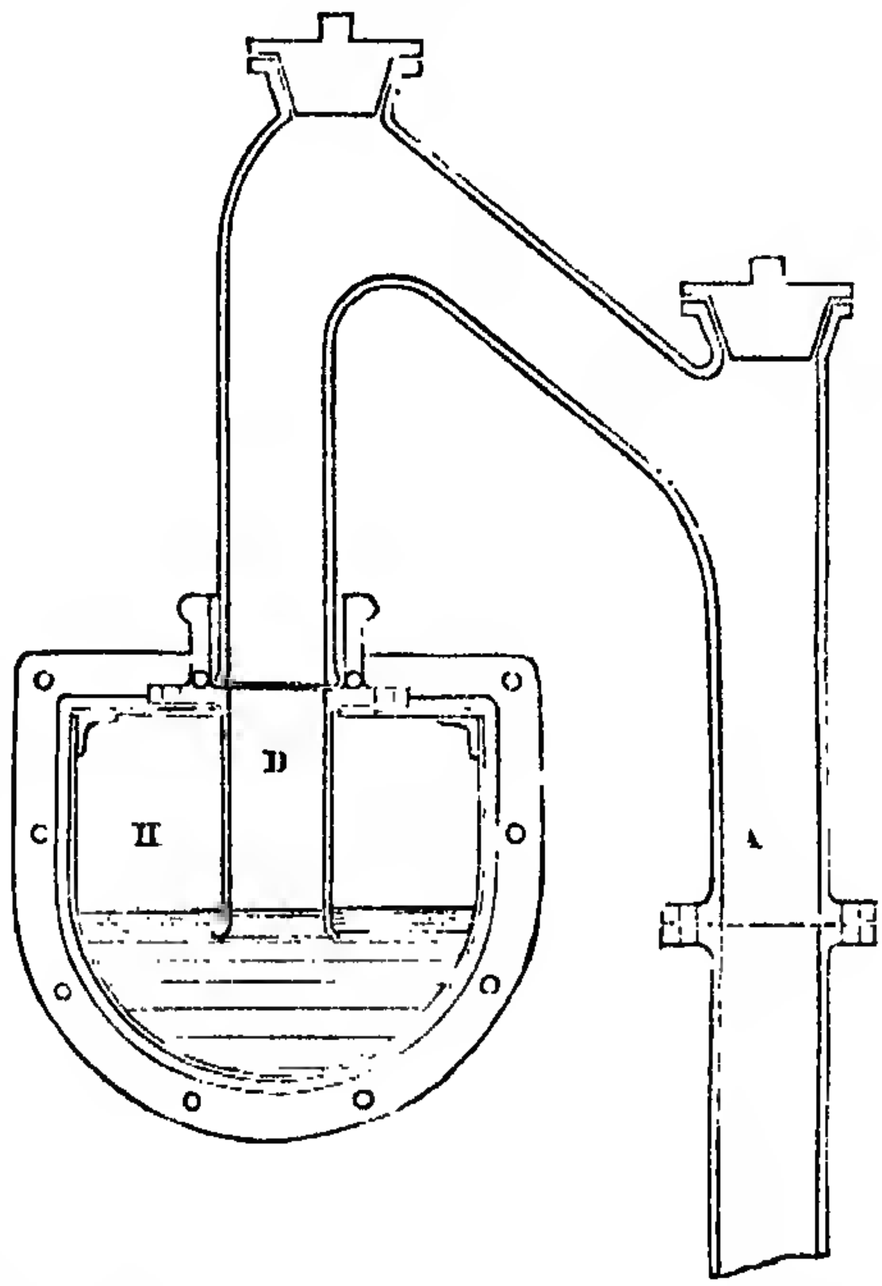
Fig. 1.



Small Gaswork for Gentlemen's Seats.

shown at E in Plate, where *a a a* represent the retorts. Much of the success of gas-making depends on maintaining the retorts at a uniform temperature; the temperature most suitable for carbonization being a dull orange, or probably about 2000° Fahr. Hitherto the furnace used has been an ordinary fire grate, the fuel being the coke drawn from the retorts. But within the last few years gas regenerative furnaces, the invention of the late

Fig. 2.

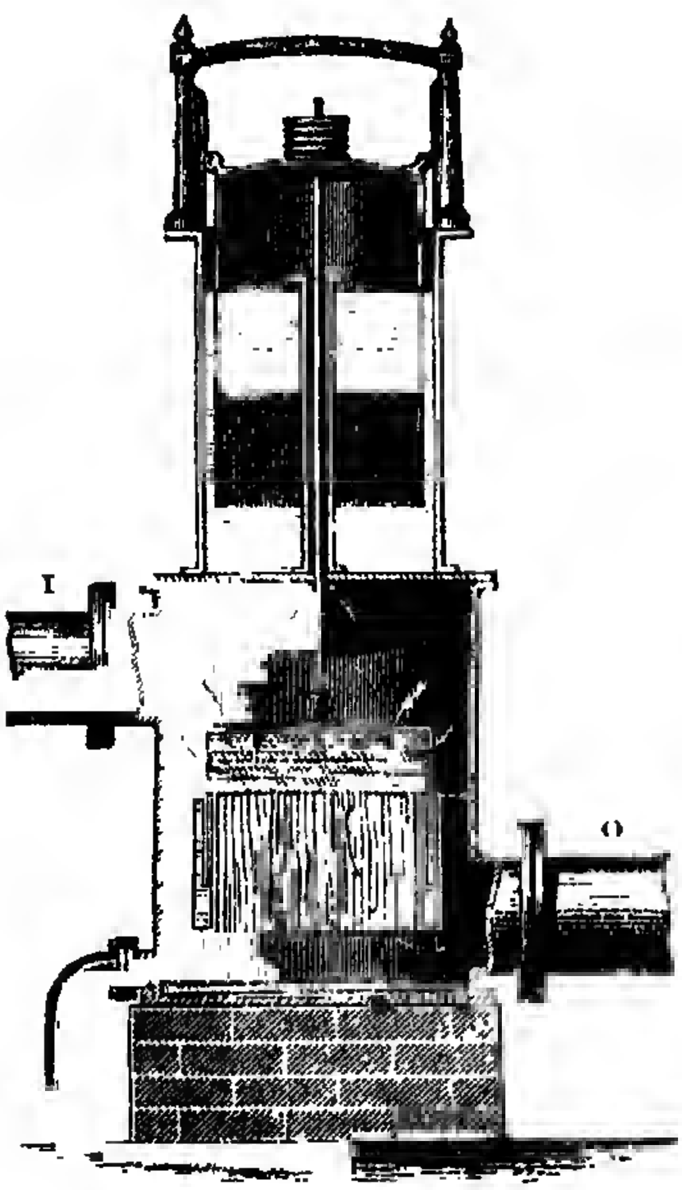


Sir W. Siemens, have been introduced into many gasworks. These furnaces effect a considerable saving in fuel, and insure more regular heating of the retorts. The duration of the charge, or the length of time the coal is allowed to remain in the retort, depends on the quality of the coal. With cannel coal three to four hours is usually sufficient to drive off all the gas; while with Newcastle caking coal from five to six hours are required.

The gas, which leaves the retort by the outlet or ascension pipe, as it is technically termed, passes into a long tube or trunk lying along the top of the retort benches and a few feet above them. This is called the hydraulic main, and is a beautifully simple contrivance which serves the purpose of a series of self-acting valves for the retorts. Were it not for some such arrangement it is clear that when the retorts were opened to be recharged the gas in the holder would flow back through the pipes and out at the open retort mouth. The arrangement by which the hydraulic main prevents this will be readily understood by referring to fig. 2, where H represents a cross section of the hydraulic main, which may be either round or ⌓-shaped, and is about half filled with liquid. At first water is put in, but this is soon displaced by tar. A is the ascension pipe from the retort, which communicates with the dip

pipe D, the open end of which dips into the liquid to a depth of about 1½ inch. The gas which is formed in the retort has only to overcome the pressure caused by this 1½ inch of liquid, when it freely bubbles through into the space above, while it is evident that gas cannot pass from this space into the pipe, the mouth of the pipe being hermetically sealed. Notwithstanding the simplicity and perfect efficiency of this arrangement objection has been

Fig. 3.



taken to it—first, because of the pressure it causes in the retorts; and secondly, the gas is supposed to suffer injury by being caused to bubble through the tarry matter in the hydraulic main—and several devices have been invented to act as a substitute. These mostly consist of valves either self-acting or operated by hand. We doubt, however, if the advantages of these arrangements at all compensate for the greater simplicity and security of the hydraulic seal.

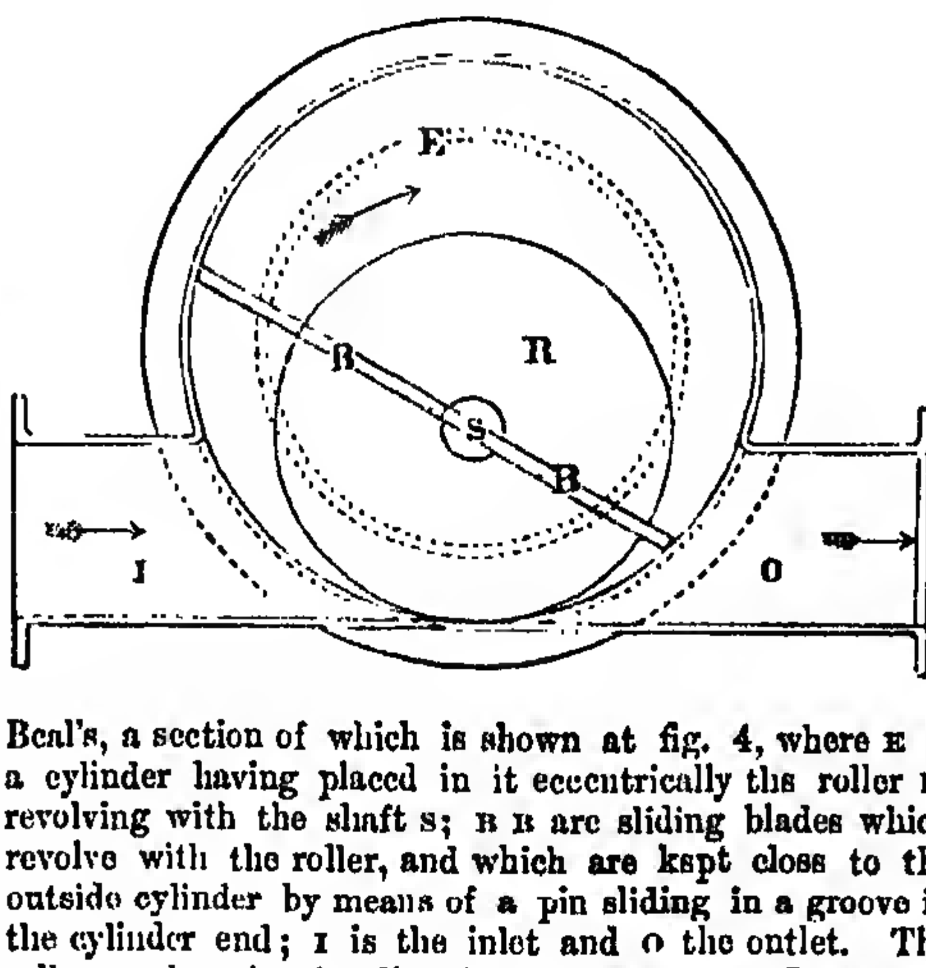
The gas passes from the hydraulic main to the condenser, the function of which is to cool the gas to about the temperature of the surrounding atmosphere, thus condensing out of it the tars and aqueous vapour. There are many arrangements of condensers; they may, however, be generally described as consisting of a series of pipes or boxes, in which the gas is exposed to a large extent of cooling surface. A common arrangement is that shown at *e* on Plate, and consists of a series of annular tubes made of thin malleable iron sheets. The gas passes through the annular space between the tubes, the outer and inner tubes being freely exposed to the air. The tar which is condensed is deposited at the bottom of the tube, from whence it flows to the tar well. Care has to be taken that the condensation is not too rapid or too great, otherwise much of the carburetted vapours, on which the illuminating power of the gas mainly depends, will be removed with the tar.

After the gas leaves the condenser it usually contains considerable quantities of tarry or sooty particles suspended in it. In order to remove these, in many works what is called a dry or tar scrubber is employed, which is a vessel arranged with a series of perforated plates, or otherwise filled with material so arranged as to subject the gas to a rubbing action, or to make it impinge against surfaces. One arrangement of this kind, invented by MM. Pelouze and Andouini, is represented at fig. 3. It consists essentially of two perforated cylinders of sheet iron so arranged that the perforations of the inner cylinder are opposite the solid parts of the outer cylinder, thus subjecting the gas first to the rubbing action in passing through the perforations, and then causing it to impinge against the solid part of the outer cylinder. The gas enters by the pipe I, and leaves by the outlet O. The cylinders are so arranged that they rise or fall according to the pressure of gas, thus exposing a greater or less surface to the action of the gas.

The next operation to which the gas is subjected is washing or scrubbing, the object of which is to remove the ammonia. There are many different varieties of scrubbers, for a description of which we must refer our readers to the various scientific treatises on gas manufacture. The object of them all is to expose a large wetted surface to the action of the gas. A description of one of the most common types will serve to illustrate the object of the others. This is represented at *k* on Plate, and consists of a square or cylindrical vessel, of dimensions suitable for the size of the work—varying usually from 5 feet in diameter and 20 feet in height to 15 feet in diameter and 60 feet in height. This vessel is filled with material through which the gas may pass easily, but which will expose a large amount of surface, the material most commonly used being coke. The gas enters at E and leaves the vessel at L. A shower of water is distributed over the top of the coke, which, passing down through it, wets the whole surface. The gas passing upwards through the coke, and coming in contact with this large area of wetted surface, is completely freed from ammonia, which is absorbed by the water.

The pressure required to force the gas through the scrubbers and purifiers as well as that required to raise the gasholder is found to be prejudicial to the retorts, causing a heavy deposit of carbon and loss of gas, by leakage through cracks and pores in the retorts. In order to relieve the retorts of this pressure an exhauster or gas pump is placed between condenser and scrubbers, which draws the gas from the retort, forcing it forwards through the apparatus into the gasholder. The pumps employed are usually of the rotary kind, a very common form being that known as

Fig. 4.



Beal's, a section of which is shown at fig. 4, where E is a cylinder having placed in it eccentrically the roller R, revolving with the shaft S; B B are sliding blades which revolve with the roller, and which are kept close to the outside cylinder by means of a pin sliding in a groove in the cylinder end; I is the inlet and O the outlet. The roller revolves in the direction of the arrow. It will be evident that the effect will be to draw gas in at I and

force it out at O. The roller R is sometimes driven by a pulley and belt, but more usually it is driven direct by a small engine attached to the exhauster.

The last process in the purification consists of the removal of the sulphuretted hydrogen, the carbonic acid, and the bisulphide of carbon; this is effected by passing the gas through boxes called purifiers, in which are placed perforated trays, containing either lime or oxide of iron. In large works these purifiers are generally about 30 feet square and from 5 to 6 feet deep. The most efficient material for purification is lime prepared by being thoroughly slackened and moistened with water, so as to be entirely converted into hydrate of lime. This readily absorbs the carbonic acid and sulphuretted hydrogen; also, when it has become partially fouled and converted into sulphide of calcium, it removes the bisulphide of carbon. Oxide of iron is sometimes employed to remove the sulphuretted hydrogen. It is used in the condition of powder, and is usually mixed with sawdust or other material to render it more open, so as to let the gas pass readily through it. When the oxide of iron has ceased to remove the sulphuretted hydrogen, it is taken from the purifiers and exposed to the oxygen of the air. A portion of the sulphur is liberated, and the iron combines with the oxygen, forming again oxide of iron, the material again becoming capable of absorbing sulphuretted hydrogen. This process of revivification is continued until, when the material contains about 50 per cent. of sulphur, it can no longer be profitably employed to abstract the sulphur impurities. It is therefore removed and the sulphur recovered by calcining. Where oxide of iron is used it is necessary to pass the gas through lime to remove the carbonic acid. O O in Plate represents a section of a purifier for lime or oxide of iron. The arrows indicate the inlet and outlet; *p p* are the perforated trays containing the purifying material; O is the cover, which is rendered gas-tight by a water joint or lute, *q*, a cup being formed on the top edge of the purifier, into which the edge or rim of the cover is inserted; the cup being filled with water a perfectly gas-tight joint is formed. The cover has, of course, to be removed each time the purifier is filled.

The gas, now completely purified, passes on to the gasholder, on the way to which it usually has to go through the station meter, which measures the quantity made. At S in Plate is shown in section the construction of the gasholder. A tank T, constructed of brickwork and rendered water-tight by puddle or otherwise, is filled with water to within about 6 inches of the top. The inlet and outlet pipes, I and O, pass down through the bottom of the tank, and rise up above the surface of the water. The gasholder, S, is a sheet-iron bell, the open mouth of which is immersed in the water in the tank. As the gas enters from the retorts it fills the space between the surface of the water and the interior of the bell, with a pressure sufficient to raise the bell. When the outlet pipe is opened the holder falls by its own weight, forcing out the gas. The gasholder is guided by columns and framing, and has often back balance weights attached to it to lessen the pressure required to raise it. Large holders are constructed on what is called the telescope principle; this is done in order to save excavation. In this case the holder is made in two pieces, one larger in diameter than the other, as shown in Plate, where H is the inner holder and H′ the outer. On the lower edge of the holder a cup C is formed, and on the top edge of H′ is a similar cup, but inverted. When the inner holder has risen to the surface of the water, the cup C, which is of course filled with water, catches the inverted cup on the outer gasholder; the two holders then rise as one vessel, the water in the cup forming a hydraulic joint between the two. It will thus be seen that the tank has only to be half the depth of the holder. Holders are sometimes made in three pieces, in which case the tank is only one-third the depth.

Gasholders are now made of very large dimensions, the largest being that recently erected at the South Metropolitan Gasworks, in London, which is 212 feet in diameter and 156 feet high, and contains about 5,000,000 cubic feet of gas.

On the outlet pipe leading from the gasholder to the street mains there is usually placed a governor or self-acting valve, the function of which is to maintain a steady pressure on the mains, whether the consumption is large or small. One form of governor is represented in Plate, where H is a small gasholder, having attached to it a conical valve V, which closes the inlet passage; the holder is loaded by the weight W, to give a certain desired pressure in its interior, and consequently in the outlet pipe O. The holder rises and falls as the pressure in the outlet increases or diminishes, and shuts or opens the valve V, until equilibrium is restored.

The tar and ammoniacal liquor extracted from the gas during the process of manufacture, at one time looked upon as being worthless nuisances which it was difficult to get rid of, are now a source of large income to the gas manufacturer. From the tar there is extracted naphtha, benzole, and other hydrocarbons of the naphtha series—creosote-oil and pitch; more recently the discovery of anthracene and aniline, the basis of those beautiful dyes which have become so well known, has greatly increased the value of tar. The ammoniacal liquor yields sulphate and carbonate of ammonia, as well as the liquid ammonia. The most important of these is the sulphate of ammonia, which is found to be a valuable manure.

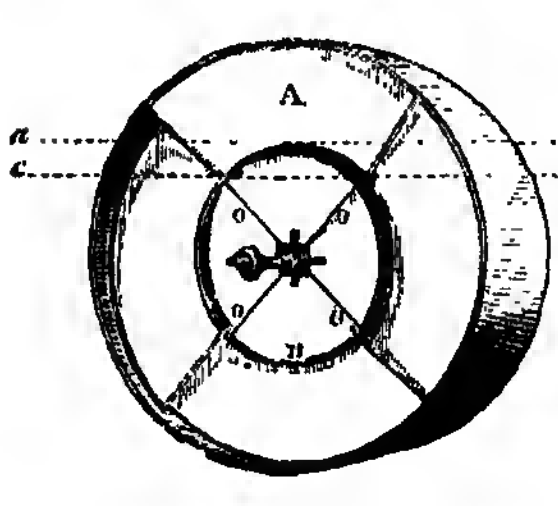
In some towns in the United States of America illuminating gas is made by passing steam over red-hot charcoal, the decomposing water forming a gas composed of hydrogen and carbonic oxide, which is afterwards carburetted with light petroleum spirit. Gas is also made from oil for some purposes. The gas used in Pintch's system for lighting buoys at sea, and also for lighting railway carriages, is made by passing the vapour of petroleum through a retort heated to redness, where it is partially decomposed, and a permanent gas is obtained having an illuminating power of about forty candles. This gas is compressed to about six or seven atmospheres, which enables a quantity sufficient to light the carriages for many hours to be carried in a small vessel placed underneath the carriage; and in the case of gas-lighted buoys, the buoy contains a quantity sufficient to keep a light burning constantly for several weeks.

GAS MEASUREMENT. As illuminating gas is invariably sold at a fixed rate per thousand cubic feet, its accurate measurement is of the utmost importance. Whatever be the form of the instrument employed for this purpose, the materials of which it is made, or its peculiar mechanism, one uniform principle necessarily governs its construction. The various parts must be so arranged and so adapted to each other, that all the gas which enters at one part and passes out at another shall be accurately measured, and by the self-acting motions of the measuring chambers, the quantity recorded. The internal working parts, as well as the outside case, should be constructed of durable materials; the mechanism should be simple, nicely adjusted, and offer the least possible amount of resistance to the passage of the gas.

There are two kinds of gas meters, known respectively as wet and dry meters, of each of which there are several modifications. The *wet meter* consists externally of a cylindrical case of cast-iron or strong tin-plate resting on its circumference by means of a supporting base, the interior being more than half filled with water. The measurement of the gas is made by a hollow-chambered drum, which revolves on a horizontal axis inside the case, the pressure exerted on the gas from the gasometer at the works through the street main (and which at this point is

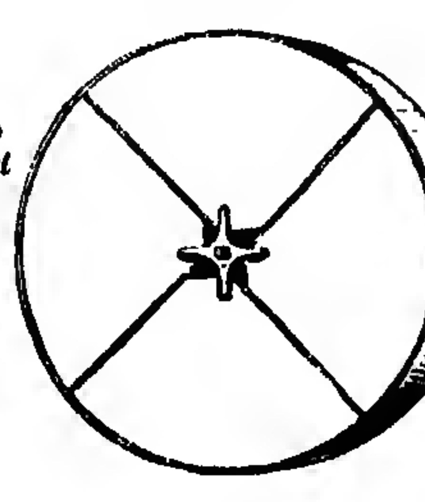
usually equal to a column of water 2 inches in height at night and about 1 inch during the day) supplying the motive power by which the drum is driven round. The drum is divided into four chambers by partitions running in a slanting direction from back to front, and presenting a section of a four-threaded Archimedean screw. The drum has on one end a common cover with an opening in the centre admitting a pipe, by which the gas enters the compartments of the drum, the opening being below the surface of the water, so as to be sealed by it. The inlet pipe after entering the opening is bent up, so that its mouth is above the level of the water. From being within the cover the gas finds its way through a slit into one of the four chambers into which the drum is divided. Each chamber, before being charged with gas, is almost entirely under water. The gas presses between the surface of the water and the partition of the chamber, and in raising the partition turns the drum on its axis and brings the chamber above the water, filling it at the same time. The outlet slit of the chamber is on the side of the drum nearly opposite to the inlet slit, and is open to the case of the meter. The parts are so arranged that this outlet remains sealed under water till the chamber is completely filled by gas, by which time the revolution of the drum has brought the inlet slit of the next chamber above the water, and it is ready to receive the gas. The filling of the next chamber carries further round the one already filled, causes its descent into the water as it revolves, and completely expels the gas by the outlet slit. Only two of the chambers can be in action at the same instant. The bottom of the measuring chambers being defined by water, the level of which constantly varies from evaporation, it is obvious that its measuring capacity must be subject to constant change, and the indications of measurement must therefore be more or less fallacious; the limits of variation, however, being, as provided by Act of Parliament, 5 per cent., *i.e.* 2 per cent. in favour of the seller of the gas and 3 per cent. in favour of the buyer. On the front of the case of the meter is placed a box into which the axis of the cylinder extends, having a spiral worm-wheel on its end. This wheel actuates an upright spindle, which again moves a train of wheels, by which the hands of the dials are worked. The ordinary gas-meter dials register hundreds, thousands, and tens of thousands of cubic feet, and there is in some cases a testing dial registering either 1 or 2 cubic feet. The front box also contains the filling and overflow pipes for the supply and adjustment of the water, and the entrance chamber by which the gas is admitted and in which the float valve is placed. When water is poured into the meter the excess runs off by the waste pipe, and when by evaporation it falls too low the valve, which is supported by a float, closes the inlet opening and shuts off the gas, so that the meter is useless until sufficient water is added to raise the float and open the valve. It is evident that wet meters are unsuitable for very cold or very hot climates; in the first case the water freezes, and in the second it evaporates rapidly and is apt to condense in the pipes, causing constant variations in the pressure of the gas at the burners, an effect which is also observed in our own temperate climate when the meter is placed in a warm part of the house, *e.g.* the kitchen. Both of these inconveniences may be remedied, to a very large extent, by filling the meter with glycerine or a mixture of equal parts of glycerine and water.

Fig. 1.



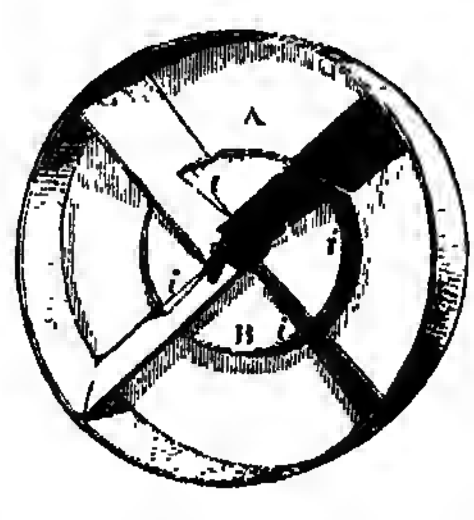
Front view of Drum with hollow cover removed.

Fig. 2.



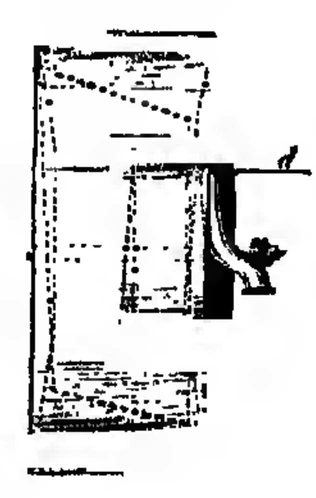
Back view, same as ordinary meter.

Fig. 3.



Back view, showing inner drum.

Fig. 4.



Side view, partly in section.

Much skill and ingenuity have been expended in the construction and interior mechanism of wet meters, in order to lessen or remove the serious defect of the constant variation of the water-line, and the consequent irregularity of the registration. There are three distinct means of obviating this defect—(1) by the use of a vessel filled with water and having only one small opening at the bottom, below the level of the water in the meter, an arrangement similar to the common bird-fountain; (2) by the application of a somewhat large float fixed to a spindle having the form of a segment of a short cylinder, which falls as the water evaporates, and so maintains the level of the water nearly constant; and (3) by the use of a supplementary drum moving concentrically with the ordinary drum, as proposed by Mr. Warner of the South Shields Gasworks. This meter, further improved by Mr. Cowan of Edinburgh, and generally known as the Warner and Cowan meter, will be best understood by reference to the ordinary wet meter. In this, the water-line being above the axis of the wheel or drum, the measuring portion is an annulus, perfect in measurement at its highest water-line (by which the registration is adjusted), but increasing in capacity with the lowering of the water-line, and thus registering against the seller of the gas. By supposing the water line to be *a b* (fig. 1), and the measuring portion of the drum the annulus A, it will be seen that any variation of the water-line will decrease the inner circle B and enlarge the annulus, to the prejudice of the gas vendor. The object of Messrs. Warner and Cowan's invention is to practically maintain a fixed capacity of annulus with a varying water-line, and thus obtain a perfect measure. By the several views of the drum shown it will be seen that a portion of the drum A is occupied by an inner drum, B, which is constructed precisely the same as the outer drum, only the arrangement of the partitions is such that the gas passes through the drum in the opposite direction to the larger one—from back to front; the inlets, *i i* (fig. 3), being within the chambers of large drum, from which they are filled, and the outlets, o o (fig. 1), being under the hollow cover, into which the gas is discharged from chambers of small drum. By section, fig. 4, it will be seen that the inner drum is about half the depth of the larger one, and as the water-line, c *d*, is always within the inner drum, one half of the outer drum must be a rigid annulus, the

other half varying with the water-line. As the inlets of small drum are within the chambers of large drum, it follows that a portion of the gas within the chambers (equal to the gas capacity of small drum) will pass through it from the large drum, and be thus returned under the cover for remeasurement. Therefore any alteration of the water level will affect both drums equally, and make no practical difference in the quantity passed—the drum in action being changed from a variable wheel to an unvarying annulus. The passage of the drum through the water is in no way affected, as shown by the difference of pressure between inlet and outlet, being practically the same as in the ordinary wet meter.

The dry gas meter, when constructed upon the most improved principles, is a measuring instrument of great accuracy, although not so durable as the wet meter. A good dry meter must be self-acting, and must work continuously, or at intervals, without requiring adjustment or interference of any sort. The ordinary wet meter requires, from time to time, to have its water renewed, and in the interval the measuring action is constantly departing further from accuracy. Once put in action the dry meter gives no further trouble; it is not liable to derangement either in hot or frosty weather, and is therefore adapted to all climates and all seasons. In passing through it, the gas takes up no additional moisture, as in the wet meter, to increase the risk of annoyance from deposit of water in the pipes. It does not require to be placed in the basement of a building, it works with somewhat less pressure than the wet meter, and cannot be tampered with so readily as that instrument. On the other hand, inconvenience frequently arises from the hardening of the leather of the measuring chambers, resulting in unsteadiness of the light; the smooth-faced valves sometimes slide with difficulty, owing to a deposit of tarry matter upon them, and the *life* of a dry meter is considerably shorter than that of a wet meter placed under similar conditions. To insure accuracy of registration they should be tested every five years. In the hands of British and French makers, the dry meter assumes various forms; but one of the most approved British construction will suffice for a notice in this place, as involving the principle common to all, with special merits peculiar to itself. The dry gas meter to which reference is to be made, is the result of efforts of many inventors directed to the one common end of producing a reliable instrument of this kind. The essential characteristics of this meter were devised by Mr. William Richards, and perfected by Mr. George Glover and other meter manufacturers. It consists of a rectangular external case, inside of which are two chambers, which are separated from each other by a plate which stands vertically in the centre of the case. From this fixed centre there extends on either side a cylindrical compartment, which is formed of extremely pliable leather, and closed at the free and opposite end by a metal disc. The metal discs travel and serve the purpose of pistons; they are kept vertical in position and parallel in motion by a kind of universal joint adapted externally to each. The space through which the disc can travel defines the capacity of the cylinder, and affords the means of measuring the gas. This distance is governed by metal arms and rods, and when once adjusted cannot vary. Each chamber is thus divided off by a flexible partition, which, like the diaphragm in the human system, moves backwards and forwards, the motion communicating with combined inlet and outlet valves placed on a shelf over the discs. These valves operate with remarkable smoothness and regularity. By the introduction of various slots and pins motion is given to a worm-wheel, which communicates with the train of wheels by which the pointers of the index are moved. There are now about as many dry meters in use as those of the other kind, and by most consumers they are preferred as being less troublesome; on the other hand most gas companies prefer wet meters, as requiring less repair, and being in the end less expensive.

By the Sales of Gas Act gas meters must be so constructed and regulated as to register not more than 2 per cent. in favour of the producer nor more than 3 per cent. in favour of the consumer of the gas, thus allowing a range of 5 per cent. In each of the large towns in the kingdom inspectors are appointed under the Act, who place an official stamp on all meters found by them to register within the prescribed limits of error. All meters must be tested at intervals not exceeding ten years, but this period is acknowledged to be too long, and it is expected to be reduced to five years when the Act is revised. Any consumer who has reason to believe that his meter is defective can have it tested by the inspector of his town or district on payment of a very small fee, and if found to be inaccurate, in the sense of registering too much, he can claim a reduction on his gas account for the past year.

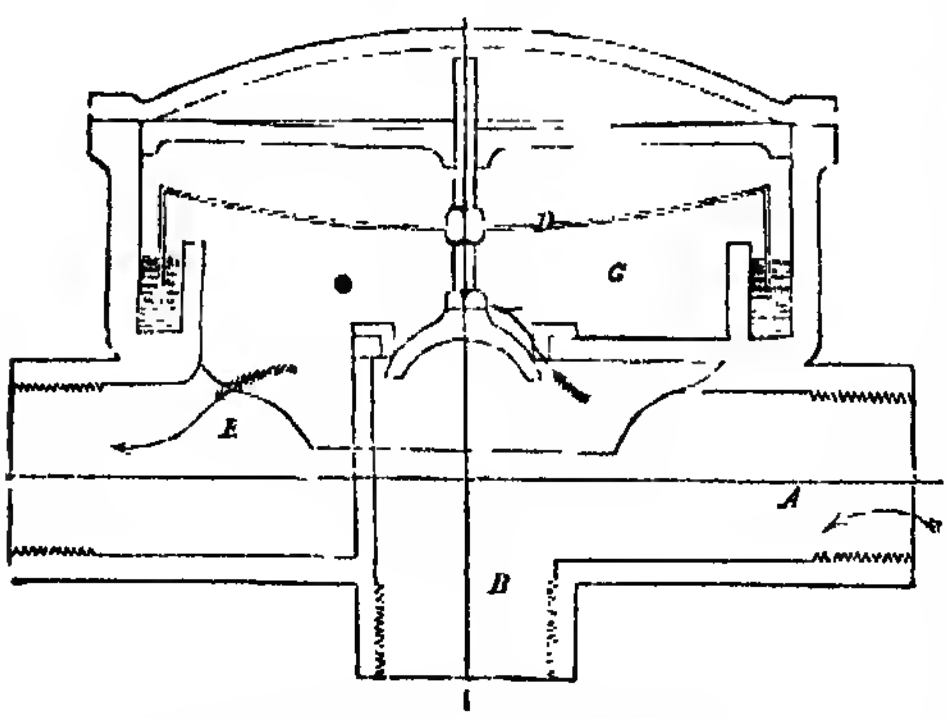
Gas standards, or *standard gasholders*, are instruments used in the testing of gas meters. They are three in number, and differ from each other in capacity, being severally one, five, and ten cubic foot measures. The original set of these instruments has been placed in the custody of the comptroller of the exchequer, and is kept in the standards department of the Board of Trade. In terms of the Act a duplicate set of them was supplied to each of the cities of London, Edinburgh, and Dublin, to be employed for the statutory testing of the meters used by the consumers of gas, and for the verification of the test-holders used by meter makers in these cities. Copies of the holders, verified and stamped at the Board of Trade, have since been supplied to the authorities in most of the large towns throughout the three kingdoms, as it is obviously of the greatest importance both to consumers and suppliers of gas that their meters should be easily verified. The gasholder or gasometer consists of an inverted cylindrical vessel, commonly called "the bell," which dips more or less into the water in the tank which surrounds it, according as there is less or more gas in the bell. The bell is suspended by means of a flexible steel band or a flat jointed chain passing over a large wheel, and to the other end of the band or chain is attached a fixed weight, together with a number of adjustable parts, by means of which any desired pressure of gas may be obtained from ·1 up to 3 inches. In order to compensate for the loss of weight when the bell is immersed in water, there is fixed to the wheel a cycloid with a weight sufficient to maintain the equilibrium. An engraved scale on the side of the bell is graduated to cubic feet and to decimal subdivisions of a cubic foot, and a microscope of low power, with a fine wire drawn across the end next the bell, is attached to the framework of the tank, for the purpose of reading off the quantity of gas in the apparatus. A thermometer and a pressure-gauge in the bell indicate the condition of the gas within upon the two essential points of temperature and pressure. A system of inlet and outlet pipes and taps, and adjusting screws for levelling the tank and securing the vertical movements of the bell, complete its elaborate arrangements.

The standard gasometers in possession of the government, and their several derivatives, were executed by Mr. George Glover, who held a patent for their construction. Sir George B. Airey, astronomer-royal, described them in his report to the government "as being to all intents and purposes perfect."

Gas regulators are local governors of the supply of gas, and are of two kinds—those of larger size, suitable for controlling the gas required for a dwelling-house or factory, and those intended to regulate the supply to a single burner. The object of these instruments is to restrict the flow of gas to the quantity or pressure required to give the best illuminating effect proportional to the gas consumed. The simplest regulator is that in which a leather diaphragm

actuates a ball-and-socket arrangement placed in an upright pipe conveying the gas. When the pressure in the gas-main is increased the diaphragm rises, bringing with it the ball, and partially closing the inlet of the gas. This instrument can be regulated to deliver gas at any required pressure by means of small weights placed on a spindle, rising

Fig. 5.

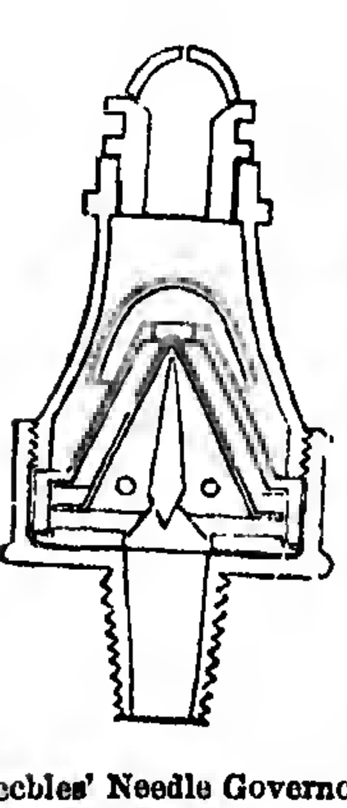


Busch's Patent Mercurial Regulator.

A, Inlet for Horizontal Pipe. B, Inlet for Upright Pipe.
D, Disc constructed of Glass. C, Upper Gas Chamber.
E, Outlet.

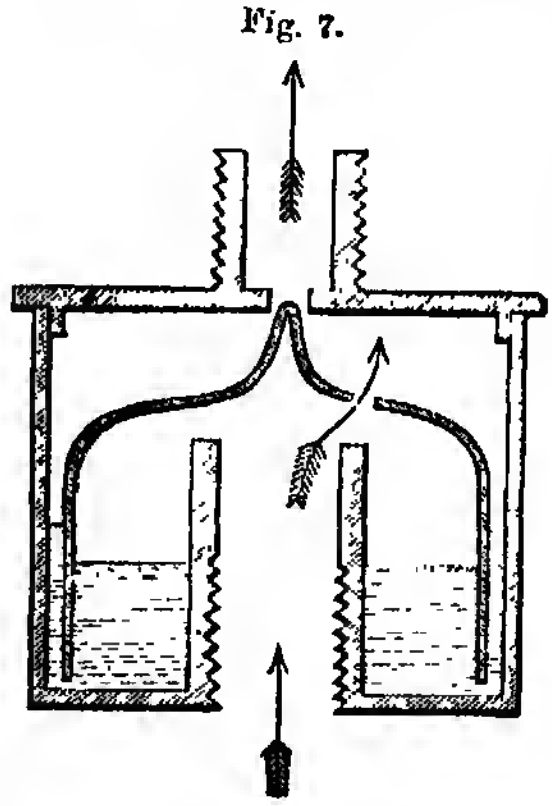
from the centre of the diaphragm. There is also an excellent regulator on the same principle, but in which the leather diaphragm is substituted by a thin glass bell floating in mercury. This regulator is represented in fig. 5. Burner regulators are usually constructed of a tube about ⅝ inch wide, with an exceedingly light metal disc or cone, the rising of which by the pressure of the gas causes the partial closing of the outlet opening of the gas. One of the best burner regulators is the "needle governor" of Mr. D. Bruce Peebles of Edinburgh, which is represented in section in fig. 6. Another regulator, Giroud's rheometer,

Fig. 6.



Peebles' Needle Governor.

Fig. 7.



Giroud's Rheometer.

fig. 7, gives a fixed *quantity* of gas without reference to pressure, and consists of a very light metal bell, with a small opening near the top, floating in glycerine. The upper part of the bell is formed into a cone, which enters the pipe that ascends to the burner. This regulator is used chiefly in street lamps, but the dry regulators of Peebles, Borradaile, and others are in some respects preferable.

GAS PHOTOMETRY. Equally important with the accurate measurement of gas is the determination of its photogenic value or illuminating power. There are three leading qualities of gas in use in this country:—(1) Common English gas, as supplied in London and most of the large towns in England and Ireland, having an illuminating power of from fifteen to sixteen candles; (2) English cannel gas, as manufactured in several cities and towns in England, such as Liverpool, Manchester, and Carlisle, having an illuminating power of about twenty candles, and sometimes as much as twenty-two candles; and (3) Scotch cannel gas, as made throughout Scotland, with an illuminating power of from twenty-five to thirty candles. The standard of comparison in every case is a sperm candle, six to the pound, and burning 120 grains per hour. In France, however, a lamp burning colza oil is used, and this gives an illuminating effect equal to 9·4 of our standard candles. For burning gas of low quality (from fourteen to nineteen candles) the burner employed is that known as Sugg's London Argand. The exact dimensions of this burner, the number and size of the holes, and the height and diameter of the chimney, are all exactly defined by Act of Parliament. For gas of from nineteen to twenty-three candles the burner usually employed is a batwing, having a rather large top and a slit of about ·015 of an inch; and for cannel gas of twenty-five candles and upwards the burner (as defined in the Glasgow Gas Act, 1869) is a union or fish-tail, consuming 5 cubic feet of gas per hour under the pressure of a column of water half an inch in height. In all cases the consumption of gas is regulated to 5 cubic feet per hour. The simplest form of photometer is that in which a small rod (such as a common pencil) is placed in front of the two lights to be compared, so as to form a < with an angle of about 30″, with a sheet of white paper behind to receive the two shadows. If the lights are equal the shadows will be of the same intensity, but if otherwise, equality is readily established by moving one or other of the lights back or forward. The distance between each light and the upright rod is now measured in inches; the figures squared, and the greater divided by the less, gives the relative illuminating effects of the two lights. This crude instrument has long been superseded by the photometer of Bunsen, several important improvements on which have been made by Wright, Sugg, and other English makers. The following is the most perfect form of the instrument:—In the middle of a room, well ventilated but without perceptible currents of air, with walls and ceiling painted of a dull black, stands a strong deal table (also blackened) 10 feet long and 2 feet wide, upon which the photometer bar, 100 inches long, and accurately divided off to show the number of candles by simple inspection, is firmly fixed at such a height that the "sight-box" which slides upon it is on a level with the eyes of the operator. At one end is placed the gas burner and at the other two sperm candles, the flames being exactly 100 inches apart, and in a line with the sight-box. The latter contains a disc of drawing-paper with a spot of about an inch diameter saturated with spermaceti in the centre, and on each side a mirror to throw the reflection of the two sides of the disc to the eyes of the operator. If a distinct spot is seen on either side, or both sides, of the disc, the sight-box is moved to one side or other until equality is obtained, indicated by the disappearance of the spot; the number of candles is then read off on the scale below. The gas is first passed through an experimental wet meter, with a dial showing the consumption of gas per hour by the observation of one minute, and provided with a three-way tap by which the gas may be at will either passed through the meter or right on to the burner without going through the meter, being controlled in either case by the action of an

exceedingly delicate governor. The meter face also contains the second hand of a clock inclosed in the meter case, and this boing superposed over the index hand of the meter, the two hands travel exactly together when the gas is burning at the rate of 5 cubic feet per hour. The candles are suspended from one end of the beam of a delicate balance, and appropriately fixed in a candle holder. When an experiment is to be made the candles are lighted and the meter set in action, and in ten minutes the candles are in good condition and the meter cleared of the gas which it previously contained. When after this lapse of time the index comes to zero the three-way tap is turned, and the clock-hand is also set to the same point. The candle-balance is adjusted so that the candle end is slightly heavier than the other, and when the long pointer indicates equality the gas tap is turned and the clock put in action by moving a pin or catch on the top of the index box of the meter, which for convenience of observation is placed a little to the right of the candles. A 40-grain weight is then added to the candle holder (this being the standard consumption of two candles in ten minutes), and the observations are made with the sight-box, one each minute, the last being taken when the hand of the clock has made about nine and a half revolutions. The pointer of the balance is now closely watched, and when it comes to the centre, showing that 40 grains of sperm have been consumed, the gas tap is turned and the clock is stopped. The total consumption of gas is now read off and the time noted. If the candles have taken less than nine and a half minutes or more than ten and a half minutes to burn the 40 grains, the experiment is rejected as unreliable. The ten observations are added up and the mean ascertained; the result is multiplied by two (because two candles were used) and corrected first for consumption of gas by rule-of-three calculation, and then to standard temperature and pressure, for which purpose tables have been constructed. There are various modifications of the Bunsen photometer, some of which have a 60-inch bar, some are inclosed in a box of comparatively small dimensions, and lined with black velvet to prevent reflection of the rays of light, and in one variety the disc is fixed and the candles move backwards and forwards instead. To obviate the difficulties arising from irregularities in the burning of the candles various substitutes have been proposed, the best of which, probably, is the Methven standard, which consists of an argand burner, the light from which is restricted by passing through a plate of metal with an oblong hole in it of such size that the light is exactly equal to two candles. Other arrangements have been proposed by Crookes, Wallace, and Harcourt, but none of them have come into general use. For coloured lights (such as signal lamps), and for the arc electric light, the use of stereoscopic lenses, as recommended by Wallace, is indispensable.

Besides the photometrical test above described other means may be used to estimate the quality of coal gas. The illuminating power depends mainly upon the proportion of olefiant gas and the vapours of benzole and other hydrocarbons, and these are readily estimated by the action of bromine. The specific gravity also gives a fair indication of quality, as it varies from about 430 to 600 (air = 1000), and it may be estimated either by a glass globe, the capacity of which is known, weighed first with air and then with gas; or by transpiration of the gas and air through a minute orifice in a platinum plate. The "jet photometer" consists of a cockspur or rat-tail jet of gas 7 inches high, and the quality of the gas is estimated by the pressure in hundredths of an inch required to maintain the required size of flame.

Gas Burners.—When the quality of London gas is stated to be 16 candles, it does not mean that in the houses, shops, warehouses, and street lamps of the metropolis this value is obtained in actual practice with burners of various kinds. The figure shows, in fact, the possibilities of gas illumination, and the goal to be striven for by improvements in gas burners, and in the controlling of the pressure at which the gas is burned. In popular comparisons of the electric light with gas it has often been assumed that gas as burned in our houses and streets has reached its last stage of development, and that the battle of the rival lights is between that of electricity, with its beautiful and dazzling intensity, and unimproved and unimprovable gas. Nothing can be more fallacious. Science has of late years made many improvements in the manufacture of gas, and will doubtless make many more; while, since the electric light "scare" of 1878, numerous ingenious methods have been proposed to obtain, in common use, the full photogenic value of the gas, especially in street lighting. The British Association Reports (of 1878 and 1880) on the best means for the development of light from coal-gas of different qualities, drawn up respectively by Dr. Wallace of Glasgow and Mr. Pattinson of Newcastle, give much valuable information on this important subject.

The burner gives form to the gas flame, affects the light given out, and determines the completeness of the combustion of the gas. Burners are made by machinery in great quantities and at low prices. One firm alone (Bray & Co., of Leeds) turn out about 30,000 burners daily. Formerly they were made of cast-iron; more recently brass was used for the "hollow top" burners introduced by Wadsworth in 1860, but now they are mostly made of steatite, or a description of porcelain fitted into brass bodies. The most simple jet is the *cockspur* or *rat-tail*, consisting of a single hole drilled in the top of the burner; but it gives a poor light in proportion to the amount of gas consumed, and is now seldom used. The *fish-tail* or *union* jet is formed by drilling two holes in the top of the burner at an angle of about eighty or ninety degrees, when the two jets, meeting one another, are pressed out into a flat sheet of flame. These burners are used chiefly for cannel gas, and they give their best lighting power in relation to the gas consumed at from ·5 to ·7 of an inch. Frequently the burners are constructed with an obstruction so as to reduce the pressure in the main to something near the above figures. The *bat-wing* has a straight slit across the top; is mostly used for gas of low and medium qualities, and gives the best illuminating effect at from ·2 to ·4 of an inch pressure according to the size of flame and the quality of the gas. It may be laid down as an axiom with regard to all burners that the lower the quality of the gas, the larger should be the orifice or orifices through which it passes, and the lower the pressure. Bray has established the principle in regard to large hollow top bat-wings for street lighting, that the thickness of slit should be constant for each quality of gas, and that to obtain increased consumption the head of the burner should be enlarged to any required dimensions. In this way he has constructed burners to give a light of from thirty to eighty candles with gas of sixteen-candle power. In all these burners the gas is made to pass through a series of layers of cloth, in order to reduce the pressure to the point best adapted for the particular quality of gas for which they are made. Each sort of jet has several grades of size, known to the trade, which are intended to meet the requirements of lighting. For domestic purposes they are made to consume from 2 to 5 cubic feet per hour, and for street lighting from 5 to 20 feet, or even more.

The *argand* burner, although giving the highest photogenic value with gas of low quality, is not much used except for photometric purposes. The trouble of keeping the funnels clean and replacing them when broken, and the difficulty of regulating the supply of gas so as to obtain the best effect, limits the useful application of these burners. In 1879 Sugg introduced large argands for street lighting, with two or three concentric steatite rings; but although at the time these competed most

successfully with the electric light, they have gradually been set aside and replaced by flat-flame burners, which give nearly as much light per cubic foot of gas, and are much less troublesome. From argands of the best construction, such as those of Sugg and Silber, the gas issues at a pressure not exceeding ·05 of an inch, and the shape of the flame is determined, not by the velocity with which the gas issues from the holes, but by the height and diameter of the funnel.

The use of volatile liquid hydrocarbons (such as benzole, petroleum spirit, &c.) for enriching the quality of poor gas has long been known, and many ingenious machines have been invented for saturating the gas with the vapours of these liquids. Similar machines are employed for producing air gas, that is, common air saturated with hydrocarbon vapours. If the spirit is sufficiently volatile, and the temperature not too low, the air gas gives an illuminating power of from twenty to twenty-five candles; but it must be burned in argands with very wide holes, or in bat-wings with wide slits, and at a pressure not exceeding ·2 of an inch. Air gas is much used in the United States, and in this country it is employed for lighting mansion-houses and other buildings at a distance from a source of supply of ordinary coal gas. What is called the *albo-carbon* light has been introduced somewhat extensively in London. It consists of common gas enriched by the vapour of a solid hydrocarbon, called naphthalin, a product of the distillation of coal tar. The naphthalin is purified, and is introduced in the solid form into a receptacle which becomes sufficiently heated, when the gas is burned, to convert it slowly into vapour. The illuminating power of the gas is by this simple means more than doubled, and the light resembles that afforded by rich cannel gas.

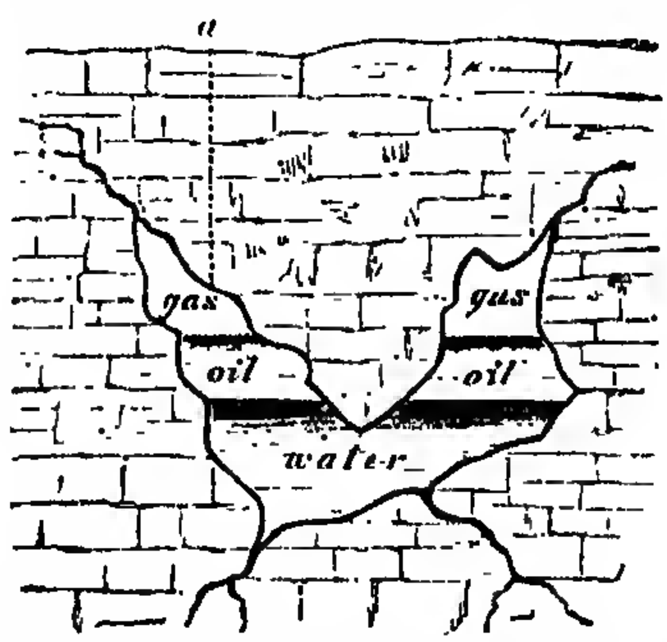
One of the most recent improvements in gas lighting is the regenerative gas burner of Sir William Siemens, in which the heat of combustion is utilized in warming the gas before it passes to the burner, and also the air necessary to burn it. This is a very economical burner for large lights, as it gives a marked increase of lighting power; but the apparatus is clumsy and unsightly, and requires constant supervision during the first half-hour after the gas is lighted. The lamps are also exceedingly expensive, and for this reason, and those already mentioned, are not likely to come into extensive use.

The experiments in street-lighting with the electric light, both in the form of the arc and in the incandescent lamps of Swan, Edison, and others, begun in 1878 and carried on to the present time, have done much to develop improved systems of lighting by gas, and to promote the desire to have well-lighted streets. They have also proved the impracticability of applying electricity for lighting except under very exceptional circumstances. One set of experiments, conducted with every appearance of fairness, showed that the arc light cost three times, and the incandescent light nearly twelve times, as much as gas.

The Bunsen jet, employed by the chemist for heating purposes, is an arrangement for mixing the gas with about two and a half or three times its bulk of air before burning, when it gives a non-luminous but intensely hot flame, which, like that of a spirit lamp, does not blacken vessels placed over it. It consists of a stand or foot with a rat-tail jet in the centre, above which is fixed a brass tube 5 or 6 inches long and half an inch or more in diameter, with two, three, or four small holes near the bottom for the admission of air. The force of the gas issuing from the narrow jet causes air to be drawn in at the bottom holes, and the mixed gas and air burns at the top of the wide tube. The quantity of air required for the complete combustion of coal gas varies considerably with its quality, common gas taking seven or eight times, and cannel gas about ten times, its bulk. Bunsen burners are now largely used for household and manufacturing purposes.

GAS SPRINGS are the vents through which gases escape from beneath the surface of the earth. Two distinct classes at least can be discriminated, which are the result of two totally different actions.

The gases that escape from one class of these springs are volatile hydrocarbons which have been liberated by the solution of substances that contained inclosures of the gas. Such springs occur in parts of Italy and Asia Minor, but probably the most remarkable are in the United States of America. Here, in the oil districts, the gases have accumulated under pressure in large reservoirs associated with petroleum and water, arranged according to their relative specific gravities; these are liberated by artificial means, such as boring, when the elastic force of the compressed gas produces those remarkable phenomena connected with the spouting oil-wells. Thus if the bore-hole were to strike either of the gas chambers in annexed cut, as at *a*, gas would first escape and be succeeded by oil, and then water, forced out by the elastic force of the gas in the other



Ideal Section of Double-chambered Reservoir containing Water, Oil, and Gas.

chamber, which would be the last to escape; if, on the other hand, either the layer of oil or water were tapped they would be the first to be forced out.

From another class of springs which have a distinct connection with volcanic action a very different set of gases escape. From some of these springs (which are found in districts where it is evident more energetic volcanic action has only recently become extinct) carbonic acid gas (CO_2) escapes either through open vents, or it bubbles up through water. Such springs are not uncommon on the shores of the Laacher See in the Eifel, such an abundance of poisonous gas being given off in some instances as to be destructive to insect life in the vicinity. But probably the most remarkable example of any occurs in the island of Java, where in the Valley of Death the gas sometimes accumulates in such quantity that it suffocates any animals that venture there.

Allied to these gas springs are the FUMAROLES or gas vents on the sides of active volcanoes; and the solfatara stage of volcanic action, when only gaseous substances escape from the crater, such as hydrogen, nitrogen, ammonia, hydrochloric acid, sulphurous acid, &c., and with higher temperatures many compounds and volatile metals. These, however, will be more fully described under VOLCANOES.

GAS TAR, one of the liquid products of the destructive distillation of coal, is a very complex substance. It is always alkaline, from the presence of ammonia. It contains aniline and numerous other bases, as well as carbolic, cresylic, and other acids of higher boiling-points. When distilled, fetid ammoniacal compounds pass over, and a light oil (coal naphtha), succeeded by a heavier oil (dead oil), containing naphthalin and a little paraffin. The residuary pitch is used for common black varnishes, and for

asphalt pavement. Steam passed through coal tar in a retort, carries over together several of the lighter products, of which crude naphtha and benzole are the chief ingredients. By a careful fractional distillation of the rectified naphtha procured from this source the following products are obtained:—1, An oil of an alliaceous odour, boiling between 150° and 160° Fahr.; 2, an oil identical with benzole, C_6H_6, boiling at 176°; 3, an oil boiling at 240°, consisting chiefly of toluole, C_7H_8; 4, an oil boiling between 240° and 290° Fahr., resembling cumole; and 5, an oil boiling between 330° and 340°, resembling cymole, $C_{10}H_{14}$. Aniline, procurable from the same fruitful source, through operating on the benzole which coal tar contains by a mixture of nitric and sulphuric acids, and afterwards employing a deoxidizing process, when pure, is a colourless oil-like fluid possessing a very high refractive power; it has a strong disagreeable odour and a hot aromatic flavour, boiling at 360°. When aniline is treated with a solution of chloride of lime a beautiful violet-blue colour is produced, which reddens by the addition of an acid. When heated with corrosive sublimate it produces a splendid red dye. By the oxidation of this substance, aniline, a great variety of colours is obtained, the tints varying with the degree of oxidation. Many other colouring principles, such as picric acid, yielding a beautiful yellow, and *bleu de Paris*, a very fine blue, are by the skill and operations of the chemist derived from various constituents of coal tar, and particularly alizarin, formerly obtained from madder, is now made in enormous quantities from anthracene, a solid hydrocarbon which comes over at the very end of the process of distillation.

GASCOGNE or **GAS'CONY**, an ancient province of France. It formed the south part of the general government of Guienne and Gascogne, and comprehending almost all the country between the Garonne, the Pyrenees, and the Atlantic, was nearly identical with the ancient *Aquitania*. The French give the name of Golfe de Gascogne to the Bay of Biscay.

GASES AS FOOD. If it is difficult to persuade persons (as it sometimes is) that water is a more necessary food than bread, seeing that by far the greater part of the body is made up of it, it is still more difficult to induce those who have not before considered the question that gases are the most necessary food of all. A food is that which supports or increases vital actions. The necessity for oxygen as a food is absolute and unintermittent. When we inspire air into the lungs we eat it as effectually as we do our bread and meat, only by virtue of another organ. The blood absorbs some of the oxygen thus provided, and some combines to form chemical compounds with the carbon, nitrogen, and hydrogen of the food. These compounds sometimes remain in the body for a time, but as a rule they are quickly thrown out as excreta. Every thought and act of man, his warmth and his vigour, use up oxygen and return an equal amount in some combination to the air. Nitrogen seems, on the other hand, chiefly to dilute the oxygen rather than to play any independent part. Inhaling pure oxygen, it is found experimentally, increases the vital waste by 10 per cent. The body is, in fact, slowly burned by so violent a chemical activity. The form of oxygen called ozone seems to have greater food properties than ordinary oxygen.

GASKELL, MRS. ELIZABETH C., one of the most noted English lady-novelists of her day, was born about the year 1820, and was the wife of a Unitarian minister in Manchester. Mrs. Gaskell, whose maiden name was Stevenson, attained a sudden celebrity by the publication in 1848 of her first novel, "Mary Barton." In this fiction the life, outward and inward, of the workers of "the metropolis of industry" was portrayed from long and personal observation, and with much grace and truth. Her characters are sometimes drawn with wonderful dramatic power, while her descriptive passages are many of them particularly graphic. Among her other works may be mentioned "The Moorland Cottage" (1850), a Christmas story; "Ruth," her second novel (1853); "North and South" (1855); "Cranford;" and "Lizzie Leigh." When Dickens started his *Household Words* Mrs. Gaskell became a constant contributor of tales and sketches. Here the last three works named above originally appeared. "Cranford" belongs to the most successful of her works, with its pictures of life and character in an old-fashioned English country town, rivalling Miss Austin in delicacy of observation, and full of a quaint and peculiar humour. Mrs. Gaskell also edited a life of Charlotte Bronte in 1857—a touching narrative which has gone through a number of editions. Among her later works were "Sylvia's Lovers" and "Cousin Phyllis." She died in November, 1865.

GASSEN'DI, PIERRE (properly *Gassend*), French philosopher and astronomer, was born of poor parents on 22nd January, 1592, at Champtercier, a village near Digne, in the department of the Lower Alps. He received his education first at Digne and then at Aix. At an early period he evinced a taste for astronomy. In 1614 he was appointed professor of theology at Digne, and two years afterwards he was invited to Aix to fill the chairs of divinity and philosophy.

The appearance of the first volume of "Exercitationes Paradoxicæ adversus Aristoteleos," which was published at Grenoble in 1624, gained for its author a well-established and widespread reputation, and Nicholas Peirese used his influence to obtain for Gassendi a canonry in the Cathedral of Digne. In 1629 a second volume of his "Exercitationes" appeared, the object of which was to expose the futility of the Aristotelian scholastic logic. Upon his return (from a visit to Holland) to Digne, Gassendi applied himself with great diligence to astronomical studies, for which his fondness had grown with his years; and he had the good fortune, on the 7th of November, 1631, to be the first to observe a transit of the planet Mercury over the sun's disc, which had been previously calculated by Kepler.

About the year 1641 Descartes, with whom Gassendi had long maintained a close and friendly intercourse, was working a reform in philosophy. Gassendi, however, forthwith attacked the philosophical system of his friend in a work entitled "Disquisitio Metaphysica, seu Dubitationes ad Meditationes Cartesii," which led to a slight coolness between the philosophers. In 1645 Gassendi was appointed professor of mathematics in the College Royal of Paris, upon the nomination and by the influence of Cardinal du Plessis. A severe cold having occasioned inflammation of the lungs, he was forced to retire to Digne for the restoration of his health. In this retirement, however, he was far from idle. In 1647 he published his work "De Vita et Moribus Epicuri." The "Syntagma Philosophiæ Epicureæ," which followed in 1649, is an attempt to reconstruct the system of Epicurus out of the extant fragments.

Gassendi returned to Paris in 1653, and the next year he published "Tychonis Brahæi, Copernici, Peurbachii, &c., Vitæ," a work which was not confined to the biography of these great men, but also contained a brief sketch of ancient and modern astronomy down to his own day. The resumption of his literary labours quickly brought on a return of his former disorder, and he died on the 14th of October, 1655, in the sixty-third year of his age.

GASTEROMYCE'TES is a group of FUNGI, distinguished from the higher forms by the reproductive organs being included in a case (*peridium*) of some kind or another. The first tribe of the Gasteromycetes is Hypogæi, which are subterranean, and their peridium is permanent. Among these is the Red Truffle (*Melanogaster variegatus*), which is sold in the market at Bath, and eaten there in preference to the common truffle. The second tribe is Phalloidiæ, which are terrestrial, and the spore-producing surface (*hymenium*) is deliquescent. Of this tribe the genus Phallus is the type. There are two species of this genus

known in Great Britain, where they are called stinkhorns, on account of their disgusting smell. *Phallus impudicus* (the common stinkhorn) is found in woods and thickets in summer and autumn. *Cynophallus caninus* is a rarer species. It grows in woods and hedges in the south of England. From the colour of its pileus, by which it may be distinguished, it is called red-headed stinkhorn. Another well-known but rare fungus is the Latticed Stinkhorn (*Clathrus cancellatus*). The receptacle forms an open net-work, the branches of which resemble sealing-wax. It is very fetid. The third tribe is Trichogastres, in which the hymenium at length dries up into a dusty mass of threads and spores. The best known of these are the puff-balls (Lycoperdon). The giant puff-ball is esculent when young. Geaster and Bovista also belong to this tribe. The fourth tribe is Nidulariacei, which has a receptacle filled with free or elastically pedicellate sporangia. The type of this section is Nidularia, or Bird's-nest Peziza. The most common, however, is *Cyathus vernicosus*, which is found on the ground, decaying dung, sticks, &c. They are pretty little fungi, resembling birds' nests, not only in their shape but also in their sporangia, which lie at the bottom of the receptacle like little eggs.

The Myxogastres or Myxomycetes, which have been included among the Gasteromycetes, are better placed quite apart from all fungi.

GASTEROP'ODA or **GASTROPODA**, a class of the subkingdom MOLLUSCA, containing such animals as limpets, periwinkles, and snails. Gasteropods may be readily distinguished from such molluscs as oysters by the possession of a distinct head, and, speaking generally, by their active habits; in these two respects they agree with cuttle-fishes. Further, Gasteropods agree with cuttle-fishes and differ from oysters by the possession of a remarkable rasping tongue, the *odontophore*, which consists of a chitinous band (*radula* or *lingual ribbon*) developed in a sac within the œsophagus and worked by special muscles. This lingual ribbon is beset with recurved spines or teeth, variously arranged in different genera. As the portion near the mouth wears away the whole ribbon is pushed forward and new substance is formed at the other end of the sac.

These molluscs generally creep upon a large expanded portion, stretching on each side in the median ventral line. This is the *foot*. In some it is a broad creeping disc, in others it is narrow and formed like a furrow, or it is thin and presents the appearance of a slim plate placed in a vertical position. The dorsal surface has a very delicate integument, which is drawn out in the form of a skirt or *mantle*, so as to partially conceal the head and foot; the space between the overhanging mantle and the body is known as the *subpallial chamber*. The head, placed in front, shows itself more or less, according to its greater or less retirement under the mantle, and is furnished with small tentacles, which are above the mouth, and never surround it. Their number ranges from two to six, and they are sometimes altogether wanting. Their proper use is only for touching, and at the most for smelling. The eyes are very small, sometimes adhering to the head; sometimes at the base, or at the side, or at the point of the tentacle; and sometimes these organs are altogether wanting. The organ of hearing consists of two round vesicles containing ciliated otoliths. Some of the Gasteropods are absolutely naked; others have only a concealed shell; but the greater number carry a shell which is capable of receiving and sheltering them. These shells are produced in the thickness of the mantle. Some of them are symmetrical, consisting of more pieces than one; others are symmetrical, but formed of a single piece; and there are also some unsymmetrical, which in species where they are very concave, and where they grow a long time, necessarily produce an oblique spire. If the reader will imagine an oblique cone in which other cones are successively placed, always larger in a certain direction than in the others, it will follow that the whole rolls itself upon the side which is least. The part on which the cone is rolled is called the *columella* or *pillar*; this is sometimes solid and sometimes hollow. When it is hollow the open end of it is named the *umbilicus*. The whorls of the shell may remain nearly on the same plane, or may extend towards the base of the columella. In the last case the preceding whorls are raised one above the other, and form what is called the *spire*, which is pointed in proportion to the more rapid descent and small enlargement of the whorls. Those shells with an elongated or projecting spire are termed *turbinated shells*. When, on the contrary, the whorls remain nearly on the same plane, and are not enveloped one within another, the spire is flat, or even concave. These are called *discoid shells*. More rarely the shell is conical or *patelliform*, like the limpet. When the upper part of each whorl envelops the preceding ones the spire is said to be concealed. That part of the shell from which the animal comes forth is termed the *aperture*. When the whorls remain nearly on the same plane, the animal, when it creeps, carries its shell disposed vertically, the columella lying across the posterior part of the back, and its head passes under the border of the aperture opposed to the columella. When the spire is elongated it is directed obliquely to the right in almost all the species; a small number only have it directed to the left when they creep; these shells are called *reversed* or *left-handed shells*. The heart is always on the side opposite to that where the spire is directed. It is therefore ordinarily on the left side; in the reversed or left-handed shells it is on the right. The contrary of this disposition holds good with regard to the organs of generation. The aperture is sometimes notched or produced into a canal, which is respiratory in its function. Sometimes there is also a posterior canal, which is excurrent.

The aperture of the shell, which is formed principally by the last whorl, is more or less large in proportion to the other whorls, according as the head or foot of the animal, which is to be constantly protruded therefrom and retracted thereunto, is more or less voluminous compared with the mass of the viscera which remain fixed within the shell. The aperture is, moreover, wider or narrower in proportion as the same parts are more or less thick. There are shells whose aperture is narrow and long; the foot, in such cases, is delicate, and doubles together for the purpose of readmission. The great number of aquatic Gasteropods with a spiral shell have an *operculum*, which is sometimes horny, sometimes calcareous, attached on the posterior part of the foot, and which shuts the shell when the animal has re-entered it and is entirely retracted within.

In fig. 5, Plate I., is represented a section through a typical Gasteropod shell, showing (*a*) the apex of the shell, (*c*) the columella, (*w*) the whorls, (*s*) the sutures, the points of junction of the whorls, (*ap*) the aperture, (*pc*) the posterior canal, and (*ac*) the anterior canal. Some of the Gasteropods are aquatic, while others are denizens of the dry land. Those of the former group are provided with lungs, which have an external communication to admit air, opening under the outer edge of the mouth. In the latter respiration is carried on by means of branchiæ or gills, the exact position of which varies much in different species; in many being inclosed in a cavity on the back, in some being lodged in a furrow between the mouth and the foot, and in others being situated upon the back of the animal, and floating freely in the water.

The heart consists of a ventricle and two auricles, one of which is often suppressed. A large liver is present. Gasteropods possess a coiled tube forming a renal organ or kidney (*nephridium*); in a few forms this is paired. The sexes are frequently united in the same individual, but self-fertilization never obtains. The nervous system is widely different in the various groups, while the ganglia are principally concentrated round the entrance to the

alimentary canal, and form a collar or ring which surrounds the œsophagus.

A few Gasteropods are bilaterally symmetrical, with the gills, renal organs, generative ducts, and circulatory organs all paired. These are the Chitons (Chitonidæ, Plate I., fig. 1), and two worm-like forms, Neomenia and Chætoderma; the two latter have been only recently added to the molluscan subkingdom. These forms Professor Ray Lankester, the latest authority on the Mollusca, has separated from the rest of the class, forming for them a subclass, Isopleura. The rest of the Gasteropoda he calls Anisopleura. In these, while the head and the foot retain the primitive bilateral symmetry, the visceral hump has been subjected "to a rotation tending to bring the anus from its posterior median position, by a movement along the right side, forwards to a position above the right side of the animal's neck, or even to the middle line above the neck. This torsion is connected mechanically with the excessive vertical growth of the visceral hump, and the development upon its surface of a heavy shell." As a consequence of this torsion the organs usually lose their bilateral symmetry, being atrophied on one side. According as the nervous system is involved in this torsion or not Ray Lankester divides the Anisopleura into Streptoneura and Euthyneura, the first of which is conterminous with Milne Edward's order Prosobranchiata, but includes also the Heteropoda, while the second contains the two orders Opisthobranchiata and Pulmonifera.

In the order Prosobranchiata (Plates I. to III.) the gills are pectinate or plumose, situated in front of the heart, and usually lodged within the mantle. The animal can usually withdraw itself entirely within the shell. The sexes are distinct. The Limpets (Patellidæ, Plate I., fig. 2), Keyhole Limpets (Fissurellidæ), and Earshells (Haliotidæ, fig. 3), are distinguished by having the gills and renal organs paired, and in some cases two auricles to the heart. Fig. 4 is a representative of a peculiar group of pelagic molluscs, which are sometimes regarded as a distinct class; they should rather be placed among the Prosobranchiata, forming a group or suborder peculiarly modified by their free-swimming life. The index letters refer to the following:—*p*, proboscis; *t*, tentacles; *g*, gills; *s*, shell; *f*, foot; *d*, disc. The remainder of Plate I. is devoted to the carnivorous Gasteropods, forming a section known as Siphonostomata, from the margin of the mantle being prolonged into a siphon which notches the lip of the shell. This section includes some of the most beautiful shells known to the collector, the cowries and the cones. The principal families included in this section are—Doliidæ (fig. 6), Strombidæ (fig. 7), Cypræidæ (fig. 8), Muricidæ (fig. 9), Buccinidæ (fig. 10), Olividæ (fig. 11), Terebridæ (fig. 12), Volutidæ, Conidæ (fig. 13). Plates II. and III. are devoted to the section Holostomata, in which the margin of the mantle is simple and the lip of the shell unnotched. The molluscs included in this section are vegetable-feeders. The principal families are Trochidæ (Plate II., figs. 14–22), Neritidæ (figs. 23, 24), Pleurotomaridæ, Scalaridæ, Janthinidæ, Cerithidæ (figs. 25–27), Melanidæ (figs. 28, 29), Pyramidellidæ, Turritellidæ, Littorinidæ (fig. 30), containing the periwinkles, Paludinidæ (figs. 31–34), Calyptræidæ (Plate III., figs. 35–50), Naticidæ (figs. 51–59). The third section of the Prosobranchiata is Pneumonochlamyda, which contains terrestrial molluscs which have lost their gills and had the pallial chamber converted into a lung. They are readily distinguished from the ordinary land-snails, forming the order Pulmonifera, by the presence of an operculum. This section contains three families, Cyclostomidæ, Helicinidæ, and Aciculidæ. The genera Siphonaria and Gadinia (figs. 60–64) should be referred to the Pulmonifera.

The order Opisthobranchiata (Plates IV. and V.) contains marine carnivorous molluscs. Many of them are slug-like in form, the visceral hump being small and the foot large. The sexes are united. The shell is rudimentary or absent, and the mantle is frequently altogether suppressed. This order may be divided into two suborders, Palliata and Non-Palliata. The Palliata, those supplied with a mantle, occupy Plate IV. The families included in this suborder are Aplysiidæ (figs. 65–68), containing the sea-hare (fig. 65), Pleurobranchidæ (figs. 69–73), Tornatellidæ, and Bullidæ (figs. 74–81), the bubble-shells. The Non-Palliata (Plate V.) contain many forms exhibiting an extreme degradation. In all neither shell nor mantle are present. The gills, when present, are placed on the back and the sides; they are usually special developments of the body-wall; in a few no gills exist at all. It includes the following families:—Dorididæ, the sea-lemons (figs. 82–94), Tritoniadæ (figs. 95–97), Eolidæ (figs. 98–103), Phyllirhoidæ, and Elysiadæ. The Pulmonifera (Plate VI.), as the name denotes, are furnished with a lung. This organ is formed by the fusion of the edge of the mantle to the neck, so as to inclose a chamber which is lined with a fine network of bloodvessels. The respiratory orifice is small. The shell is usually large and spiral. The sexes are united. Some are terrestrial, others live in fresh and brackish water. The lung-sac has a hydrostatic function in the aquatic forms. The most important family is Helicidæ, the land-snails (figs. 104–112). The other families are Limacidæ, the slugs (figs. 113–115), Oncidiadæ, Limnæidæ (fig. 116), and Auriculidæ.

GASTON DE FOIX. See Foix.

GAS'TRIC DIGESTION. See Digestion.

GAS'TRIC FEVER, a term that is sometimes employed to designate a continued fever of long duration attended with diarrhœa, ulceration of the bowels, and enlargement of the spleen. The disease is also known in many parts of the country as low fever, slow fever, while in old medical works it is known as abdominal typhus and enteric fever. The most usual name now, however, is typhoid, and it will be found described under that title.

GAS'TRIC JUICE. This term is applied to the fluid which is the principal agent in digestion, secreted from the interior of the stomach very copiously as soon as food enters the latter. The gastric juice is a transparent, almost colourless, slightly viscid liquid, which, when obtained (through a fistula, &c.) from the stomach while fasting, has a mawkish acid and saline taste. Gastric juice possesses strong antiseptic properties, suspending putrefaction and restoring the freshness of tainted meat; it also coagulates milk, which property is independent of the presence of any acid. But the most remarkable quality of the secretion of the stomach is its solvent effect on proteids, *i.e.* nitrogenous substances, which it will even dissolve when placed in contact with them out of the body. On fate it has scarcely any action at all. The chemical composition in man is as follows:—

Water,		994·4
Solid residue,		5·6
		1000
Pepsin,	3·2	
Hydrochloric acid,		
Salts,	2·2	
Total solids,	5·6	

The action of the gastric juice is manifestly that of a ferment, and to the active fermenting principle the name of *pepsin* has been given. The products of the action of pepsin on proteids are called peptones, and they differ from ordinary proteids (and resemble crystalloids) in their greater diffusibility, in not being precipitable by heat or by most acids, and in their extreme solubility in water and in saline solutions.

GASTROCHÆ'NIDÆ, a family of molluscs belonging to the order LAMELLIBRANCHIATA. This family is composed of species which are burrowers in mud or stone. The shells are thin, gaping in front, equivalve. The hinge is destitute of teeth, and the valves are united by a narrow ligament. The animals live inclosed in calcareous tubes, or embedded in mud or stone. The valves of the shell are either free or cemented to the shelly tube. The tube itself appears to be formed by the animal to protect its elongated and partly naked body from the roughness of the sand or the rock, in the holes of which they reside.

The animal has two very long united siphons behind and a truncated finger-like foot in front. In the typical genus, Gastrochæna, both the valves and the shell are free. The valves are wedge-shaped, regular, widely gaping in front, and close behind. The species perforate shells and limestone, and line the crypts which they make with a layer of shelly matter. The holes made by a species sometimes found on British coasts, *Gastrochæna modiolina*, are about 2 inches deep and half an inch in diameter. The external orifice is flask-shaped, and lined with a thin layer of shell, which projects slightly. Ten species are known.

In the genus Saxicava the shell is equivalve, solid, wedge-shaped, and gaping at each end. The species of this genus are few in number, but are very widely diffused, the same species even being found in many and distant parts of the globe. They are usually found burrowing in limestone rocks, the animal being fixed by the byssus to the side of the hole it excavates. They are also found in crevices of rocks, shells, corals, or among seaweed. The manner in which these molluscs bore is thus explained by Mr. Hancock:—The thickened portion of the mantle of the Saxicava is armed with a rough layer of numerous crystalline particles of various shapes and sizes, which are imbedded in the surface, and consist probably of silex or flint, either pure or in combination with some animal matter. This forms, in fact, a kind of file, superior, however, to any of our workmen's files in this, that the surface keeps itself always in a proper state of roughness for trituration, the silicious crystals being constantly shed and as constantly renewed. This thickened portion of the mantle is also amply provided with muscular fibres, running in all directions. The animal, thus armed, attaches itself by the byssus to the rock it wishes to perforate, then brings into contact with it this portion of its mantle, and, setting the muscular fibres into motion, soon rasps away the surface. Some years ago it was discovered that the whole front of the Plymouth breakwater had been attacked by these molluscs. They never bore deeper than 6 inches. Other genera belonging to this family are Clavagella and Aspergillum (watering-pot shell).

GATA, CAPE DE, a headland on the south coast of Spain, in lon. 2° 10′ W., 20 miles south-east of Almeria. The promontory has four hills; and a crystalline mass of limestone, in which sapphires, agates, and cornelians are found, rises from the shore to the height of 210 feet. It is the ancient *Charidemum Promontorium.*

GATESHEAD, a municipal and parliamentary borough of England, in the county of Durham, situated on the south bank of the river Tyne, opposite to Newcastle, with which it communicates by a handsome stone bridge at their low levels, and with Stephenson's magnificent high-level bridge at their upper levels. The latter is 130 feet above the river, and carries the railway, with roads beneath for vehicles and foot passengers. The town is 271 miles from London by the Great Northern Railway. The parish church is ancient and spacious, and has a lofty tower. There are other churches of more modern erection, and places of worship for all denominations of dissenters. A handsome town-hall, in the Italian style, was built in 1869. The town contains a good grammar and other schools, mechanics' institute, and a free school founded by a rector of the parish in 1701. It has also an excellent dispensary, which was established after the visitation of cholera in 1831–32, in which more than 1000 of the inhabitants perished. The sanitary condition of the town was then, and for many years after, in a very bad state, but great improvements have since been made. A large portion of the river-side property, in which the houses were small and poorly built, was destroyed by fire in 1854. This facilitated the opening of some of the closer and more crowded parts, and allowed a new quay to be constructed. The town is rapidly extending to the west and south, where many new streets have been laid out and some good houses erected, and is annually increasing in manufacturing and commercial importance. There are coal mines within the limits of the borough, which are extensively worked, and employ a large proportion of the inhabitants. The chief manufactures are of brass and glass, and there are important iron-works. There are also large cement and chemical works. Shipbuilding is carried on, and the North-eastern Railway locomotive works employ about 1000 hands. At Gateshead Fell, near the town, are the quarries from which are obtained the famous grindstones known as "Newcastle grindstones," which are very extensively used at home, and also exported to all parts of the world. The municipal borough is divided into five wards, and governed by ten aldermen and thirty councillors. In accordance with the Reform and Redistribution Acts of 1884–85 the parliamentary borough returns one member to the House of Commons, and had a population of 65,803 in 1881—an increase of 17,000 since 1871. The population almost exactly doubled in the twenty years between 1861 and 1881. From the numerous Roman relics found at Gateshead it has been concluded that it was an outwork of the Roman station of Newcastle.

GATINAIS, a former district in France, partly comprehended in the province of Ile-de-France, partly in that of Orléanais, and distinguished as Gâtinais Français and Gâtinais Orléanais, of which Melun and Montargis were the respective capitals. It is now included in the departments of SEINE-ET-MARNE, LOIRET, NIÈVRE, and YONNE.

GATINE, a district of Poitou, of which Parthenay was the capital, now comprehended in the department of Deux Sèvres.

GAUGE or **GAGE,** any apparatus for measuring dimensions, capacity, and all kinds of forces. But the term is usually restricted to some particular instruments, such as the gauge of the air-pump, which points out the degree of exhaustion in the receiver, the wind-gauge [see ANEMOMETER], the tide-gauge, &c., all of which are mentioned in connection with their several subjects. In railways the gauge means the distance between the rails.

Wire-gauges are those which measure the diameter of wire, by which its size is ascertained. It is greatly to be regretted that the method of reckoning is still absurdly discrepant. Thus the high numbers of the Birmingham music-wire gauge are for stout wire, and those of ordinary steel or iron wire gauges are for thin wire. As an example, No. 17 music wire is No. 20 iron wire; and No. 17 iron wire is No. 24 music wire. Worse than this, many wire-drawers use another gauge still for brass and copper, and the gold and silver gauges differ again. None of these gauges have any scientific basis. Against this absurd and heterogeneous system (or absence of system) it is a humiliating contrast to consider the French, or, as it is better called, the metric system, with its universal and delicate measurement by hundredths and by thousandths of a metre (centimetre and millimetre). Even if we were to decimalize the inch, and agree that the sizes of all wire should be reckoned in hundredths of an inch, we should gain an immense advantage, and this has often, though vainly, been proposed. The truth is that tradesmen gain a certain

advantage in their technical terms not being understood by people.

Three forms of wire-gauge are in common use. For small wire (as music wire) the best is that made by two small oblong plates of steel set in a frame in one plane, their lower edges touching and their upper edges separated by a small distance, leaving an opening like a very elongated V. The sides of this opening bear transverse lines with the number of the wire which is stopped opposite that particular line. Larger wire or sheet metal is measured on a gauge plate surrounded by notches of the proper widths. The third sort is like a carpenter's rule, with a sliding extension-piece carrying a cap, between which cap and the extremity of the rule proper the wire to be gauged is placed, the size being then read off as graduated on the extension-piece. This sort of gauge serves for measuring many objects besides wire.

GAUGING is the method of determining by actual measurement the size or contents of a body, and especially the number of gallons contained in any vessel intended to hold liquids. The greatest use of this art is in the collection of the revenue, in which it is necessary to measure the contents of vessels of greatly varying form and size. Scientific instruments are used, as the dipping rod and sliding rule. The strength and value of spirits are determined by Sykes' hydrometer.

GAUL and the **GAULS.** In the article FRANCE it is mentioned that the Gauls were not originally the inhabitants either of the Western, the Italian, or the Eastern Gallia or Galatia. The conquest of the first was before our historical period, the conquests of the latter we know somewhat of. Considerations of race and language make us certain that the Gauls are the Gaelic branch of the Celtic nation, and enable us to assert with fair reason that they came from the East, that they are of the Indo-Germanic or Aryan stock, and that they form the first great wave of the successive invasions westward of Aryan peoples. They were men of large, sometimes colossal, size, with fair skins and red hair, or it might be ruddy yellow; brave and fickle at the same time, headlong at a charge, but weak at continued effort. Their favourite weapon was a long sword, and they were skilful charioteers and javelin-men when we begin to hear of them. But ages before any historical record they poured into the country we now call France. Here we believe they found a small quick-moving dark-eyed race, not Aryan, remnants of which still exist along the northern shores of the Mediterranean and by the Bay of Biscay. These were called the *Iberi* in Spain, the *Ligures* in Italy, the *Aquitani* in France. It is believed that in the Basque tongue their very speech has been preserved to us. The Gauls themselves were called by the Greeks *Galatoi*, *Keltoi* (the same word), or *Galloi*, and the country they had conquered (France) *Galatia* or *Gallia;* the Romans adopted these names. It will appear presently how each name has been made use of to mark distinctions of country and folk. The Gauls or Celts then drove out the dark race from the country between the Seine, the Garonne, the western sea-shore, and the Rhine. Then certain of them drove before them the Iberi across the Pyrenees to beyond the Ebro (Iberus), whence their name; but they, mingling with them produced the brave mixed race of northern Spain called by the Romans the CELTIBERI, or union of Celts (or Kelts) and Iberians. (The Romans having no letter K used C for the Greek K, a cause of many generations of confusion.) The Celtiberi were perhaps the most stubborn of resistors to Roman conquest. A third division, still prehistoric, crossed the Alps as the others had crossed the Pyrenees, and formed the Umbrian race. We now reach the times of dim tradition, and the date of 590 B.C. is given us, on slender authority, it is true, as the time when a second Italian invasion by Gauls took place. These founded Milan and settled the whole country north of the Po. The Romans, recognizing them as identical with the Gauls of the north-west (France), called them all Gauls and their country Gallia, distinguishing the French Gauls as Transalpine, the Italian Gauls as Cisalpine. The latter quickly became Romanized, and adopted Roman manners and costume, so their land was called also *Gallia togata*, Gaul of the toga; whereas Transalpine Gaul, still for many centuries to come retaining the national clothing, was called *Gallia braccata*, Gaul of the breeches, from the distinguishing garment. It was then the case that the barbarians clothed the legs (orientals and occidentals alike), while it was a mark of classic civilization that the legs should be bare—which always seems odd to us. Beyond the *Gallia braccata*, to the north, the Gauls retained their long unkempt locks in a sort of red mane, terrible to see, and this outer Gaul of the Gauls was therefore called *Gallia comata*, Gaul of the hair. These remarks apply to the early historical period and onward to the time of Cæsar.

We have now the Gauls in France, in northern Spain, in the peninsula of Italy, in the Milanese. At probably the same time as the invasion of the Milanese another body overran Switzerland, and following the line of the Alps and the Danube passed eastward, sending down a stream along Illyria, the east coast of the Adriatic. This invasion gives us the famous Helvetii (later on to give a pretext for Cæsar's invasion), the Rhœti, the Norici, and the Carinthii, who have left their names along the chain of the Alps.

Coming now to strictly historical times, we find the Gauls of the Seine, under their *Brennus* or national leader, entering Italy, B.C. 400, in a considerable horde, the chief tribe of which were the Senones. Thrusting out their kinsmen of Umbria and the Etrurians, they founded *Sena* (Siena) as their centre. In the article BRENNUS is given the legendary account of the reason why they marched on Rome. This city they took and sacked B.C. 390, eventually retiring to Gallia Cisalpina, but south of the Po, where they settled alongside the Boii, their kinsmen, who had conquered a settlement there by an invasion a few years before. Their chief town, Bononia, still exists as Bologna.

Perhaps the Senones were themselves thrust out of Gaul by a new invasion from the East; certain it is that somewhat later, a little more than three centuries before Christ, a fresh Celtic wave broke upon Gaul. The new-comers were a steadier race than their predecessors, though equally fierce. They conquered and firmly held the lands north of the Seine and Marne, upwards to the sea and the mouth of the Rhine. Cæsar calls them *Belgæ*, and they have left their Roman name for ever impressed upon their ancient home; but they probably called themselves Cymry (or Kymry). It is therefore convenient to call the entire race the Celts, and to divide them into Gauls (or Gaels) and Cymry. Both branches are well represented in our own land, the Gaels by the ancient Irish and Scotch, the Cymry by the ancient British and Welsh, and it is clear that the former were driven northward and westward by the latter. They themselves shared a like fate at the hands of the Saxons later on, so that Cornwall, Wales, and Cumberland alone now show Cymric traces. The Gauls, pressed on by the Cymry, restlessly sought room, and in addition to the influx into Italy, greater and greater eastward movements were made. At last under another Brennus they fell as fiercely upon northern Greece in B.C. 280, as their forefathers had fallen on Italy a century before. The enormous number of 150,000 foot and 60,000 horse is given as taking part, and the proud Greek myth is that the god Apollo single-handed drove the mighty host from his sacred Delphi. Whether conquered or not, the greater part of the Gauls retired or were slain; and those who remained became peaceful settlers in Macedonia and Thrace. The rest crossed into Asia and overran Asia Minor. After many struggles they were completely worsted by Attalus, king of Pergamus, B.C. 230,

and compelled to settle down in a large district assigned them. To this they gave their name, and it is Galatia to this day.

Completing the history of Galatia it may be added that this race became as Greek as the French division became Roman, but they retained much of their own customs and their language. They had a chief elected over each of their twelve divisions, and he was called a *tetrarch*; the twelve tetrarchs, controlled by a senate, appointed governors, generals, &c. Eventually one of the tetrarchs, Deiotarus, was named king by the Romans for his resistance to Mithridates, B.C. 84. Augustus made it a Roman province B.C. 25. From St. Paul's Epistle to the Galatians we learn that the Gallic fickleness still remained in this church of his own foundation, but we are debtors to these backsliding Celts for one of the most precious documents which has ever blessed and aided the struggles of the human soul.

Returning now to the historical account of the Gauls after the great Greek invasion of B.C. 280, we find the Romans who had thoroughly conquered Gallia Cisalpina during the third century before Christ (the final defeat of the Boii was in 191 B.C.), now in the next century getting a foothold beyond the Alps. The Greek city of Massilia (Marseilles) had been founded by the Phocæans, Greek people of Asia Minor driven out by an invasion of the Persians about B.C. 600; and this city, with its subordinate cities (as Nicæa, *Nice*; Antipolis, *Antibes*, &c.), was in firm alliance with the Romans. Spain was in Roman hands, and it was manifestly necessary to secure a land route to Spain. Besides, the wealth of the Gauls would have tempted them, for Greek merchants reported how the native kings hunted with a brilliant train, or kept open table in an inclosure 3000 paces square, or visited the towns in a silver-mounted chariot, scattering gold coins among the mob. This was not all a myth, for numerous gold coins of the Arverni have been collected of this period. Under pretext at first of assisting the Massiliots the Romans attacked Southern Gaul in a series of short sharp campaigns. By B.C. 123 Caius Sextius was able to found the township which, from its having some mineral springs, was called after him the Sextine baths, *Aquæ Sextiæ*, now Aix (in Provence). In B.C. 121, at the confluence of the Isère with the Rhone, a crushing victory gave all southern France to the Romans. It was decreed a province, *Provincia* (the name still remains in Provence), and Narbo (Narbonne) was founded as its capital, B.C. 118. From the Rhone to the Pyrenees one of the great Roman roads was driven. The Swiss Celts (Helvetii) were also attacked as time went on. The confusion thus produced in Gaul and Germany unsettled the whole country. The Helvetii pressed on the Gauls westward, and when a horde of Germans (*Teutones*) dashed upon Gaul, together with a nation calling itself *Cimbri* (whose name would seem to indicate the Belgic Cymry, but whose description in Livy would seem rather to apply to a Teutonic than to a Celtic people), the Helvetii aided them, B.C. 113. For years the Cimbri and Teutones defied Rome in Gaul, in Spain, and finally in Italy itself, moving from place to place, ravaging everywhere. In B.C. 102 at Aix, and B.C. 101 at Vercellæ, near the Po, Caius Marius annihilated first one division and then the other. By B.C. 58 the position of the Helvetii, who had returned to Switzerland after the failure of the Cimbri, was intolerable, and they burned their villages and descended upon Gaul by *Genava* (Geneva). Their route led through territory nominally Roman, and Cæsar, the newly appointed viceroy, seized the pretext for a war. He crushed the Celtic Helvetii, utterly defeated the Germans who had intruded among the Gallic Sequani, broke the Cymric Nervii in Belgica, and severed the long connection of Gaul with Britain in a series of the most extraordinary campaigns the world ever saw. See CÆSAR.

The condition of the inhabitants of Gaul at this time we know from the brilliant "Commentaries" of the great Cæsar. The half-barbarous tribes were split up into clans, each ruled (as also Galatia in Asia) by its elected chief. The dominant class of the tribe was comparatively small, being entirely made up of priests (Druids) and warriors; beneath these were the women, the slaves, and the children, who swelled the number to a considerable size, and who did all the work of the community. They lived in circular wattled huts, collected in open towns. Here and there a fortification existed fit to receive the whole of the tribe—a palisaded solitary hill—or an earthwork protected by morasses served for this purpose. As the tribal divisions were separate, so also were the families, each family being practically independent. It is no wonder, therefore, that the conquest of this people was easy to Cæsar. Where tribe is divided from tribe, and family from family for generation after generation, till the habit of acting together for a common end no longer exists, a nation is at the prey of the first strong hand stretched forth to seize it.

By this magnificent conquest Cæsar not only trained an army which made him master of the world, he gained the devotion of a large part of the Gauls, to whom he extended the Roman franchise, whose tribute he lightened, whose bloodstained religion he modified, and whose crushing form of slavery he abolished. Further, he threw open a new field for Roman enterprise. So splendidly did he do his work that Gaul ceased to be Celtic and became thoroughly and ardently Roman. The very speech is but Latin modernized, as has been shown at length in the article on the FRENCH LANGUAGE.

Succeeding emperors followed Cæsar's lead. Augustus divided Gaul into four provinces, respectively called *Gallia Narbonensis* (Narbonne, Provence), *Gallia Aquitanica* (Aquitaine), *Gallia Lugdunensis* (Lyons), and *Gallia Belgica* (Belgium and Picardy). The first was a senatorial province, the other three were imperial. Caligula was very fond of Lyons as a residence; Claudius was born there and always favoured it; Nero patronized the art-loving *Provincia*. The Gallic nobles were admitted to the senate. The orators and schools of Gaul were among the most famous of imperial times. In fact, Gaul, during the four centuries that it formed part of Rome, became powerful. It could thrust emperors for thirteen years upon the world—Postumus (260), Victorinus, Marius, and Tetricus, the latter finally subdued, but with difficulty, by the great Aurelian, 272. Again, in 310, Maximian, with the fancied support of Gaul, felt able to resist the young Constantine, afterwards called the Great. But Gaul suffered terribly during all these contests, as well as in the terrible insurrection of the peasants called BAGAUDÆ.

The conversion of Gaul took place about 160 chiefly by the labours of St. Irenæus, who preached to and converted the considerable Greek community of merchants residing at Lyons. By 244 there were seven bishops in Gaul, and St. Dionysius taught at Paris in 251. He suffered for the faith; his head was struck off on Mars' Hill (Montmartre), and his bones, buried at the place called by his name (St. Denis), worked miracles. But Christianity did not thoroughly take root till the fourth century, when St. Hilarius, bishop of Poitiers, and St. Martin of Tours, brought to practical effect the work so bravely sketched out by their predecessors. Constantine the Great, who made Christianity the religion of the empire, first rose to power in Gaul and Britain, and under him, as under his father, the country for a few years enjoyed great prosperity. But the barbarians so pressed on Gaul after the death of Constantine that the Emperor Julian, when Cæsar, had to use his utmost strength to protect it. His victory over seven German chieftains in 357 was almost the last great effort of the Roman power. Julian's soldiers proclaimed him

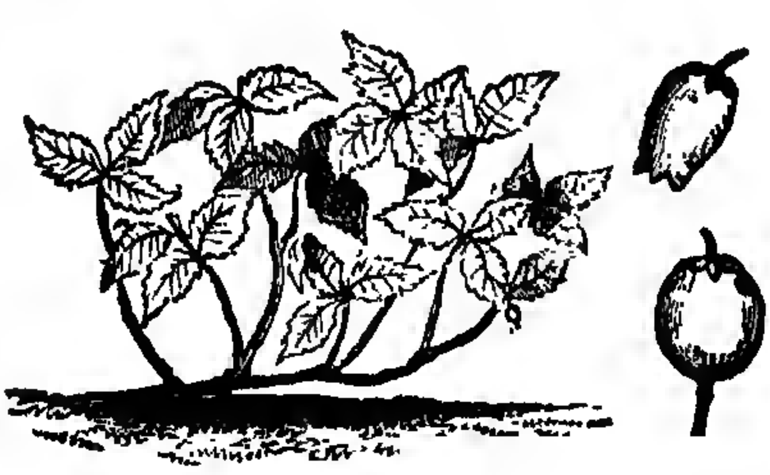
emperor at his favourite Paris in 360. The end came quickly. The Suevi and Vandals broke into Gaul in 406, the Burgundians in 413, and the Franks in 418. The Visigoths occupied the south. Chlodwig (Clovis), king of the Salian Franks, left the settlements round the Scheldt for his famous descent upon Gaul, which fell an easy prey to him in 481; and *Gallia* became *Francia*. How from a Frank conquest it became a French nation is told in the article FRANCE.

GAULT is the name applied by geologists to the lowest member of the upper cretaceous system. It rests slightly unconformable on the lower greensand, and in some localities overlaps it and the preceding strata, so as to rest on Kimmeridge clay. Typically it consists of a stiff blue clay that attains a maximum development of about 300 feet, but locally it becomes sandy or calcareous with pyritous layers and phosphatic nodules, being sometimes lithologically similar to the overlying upper greensand. The outcrop of this formation is to be found across the Isle of Wight and round the escarpment of the Weald; it also extends in a north-westerly direction across the centre of England, from Devizes in Wiltshire to the Wash on the east coast; irregular patches occur northward to Filey Bay in Yorkshire, where the red chalk is probably its equivalent.

The conditions under which the gault was deposited appear to have been highly favourable to the existence of gasteropod life, numerous remains occurring, *e.g. Natica Gaultina*, *Rostellaria carinata*, *Pleurotomaria Gibbsii*, &c. Various forms of cephalopods also abounded, as *Belemnites minimus*, *Nautilus inequalis*, *Ammonites splendens*, *Ancyloceras spinigerum*, *Hamites rotundus*; also such brachiopods as *Terebratula biplicata*, *Rhynchonella sulcata*; and Lamellibranchs, as *Inoceramus sulcatus*, *Lima parallela*, *Nucula pectinata*, *Plicatula pectinoides*, &c., besides many Foraminifera and Crustacea, with a few corals and sea-urchins.

After the deposition of the lower greensand it suffered slight erosion, and on the renewal of subsidence the gault was deposited, which consisted chiefly of fine argillaceous sediment; but towards the west, in the vicinity of the old land surfaces of Dartmoor and Wales, it partakes more of the nature of a littoral deposit, which in places graduates into the upper greensand.

GAULTHE'RIA (from M. Gaulthier, a Canadian botanist), a genus of shrubby plants, of the order ERICACEÆ, which produces very pretty rose-coloured or scarlet corollas. The succulent fruits of the *Gaultheria procumbens* and *Gaultheria Shallon* of North America are very odoriferous, and sometimes used for food.



Gaultheria procumbens.

Gaultheria procumbens (the partridge-berry, tea-berry, or winter-green) grows abundantly in woods and drier swamps in North America, from south Canada as far south as North Carolina. It is a dwarf evergreen fragrant heath plant, and possesses an agreeable aromatic odour resembling that of the sweet birch. It has long been gathered and distilled, like other fragrant plants, for the sake of the volatile oil, which in this way may be extracted from it. This natural essence is largely imported into Europe as a perfume, and is known in commerce as oil of winter-green. It is used medicinally, being aromatic, astringent, and stimulant, but its chief use is for flavouring syrups. The leaves are astringent, and are also used as a substitute for tea, or mixed with it. It was introduced into England in 1762.

Gaultheria Shallon (the shallon of the north-west coast of America) has purple berries, which are used as food by the natives. It has been introduced into Britain to serve as food for pheasants.

There are about ninety species, the greater number of which are found in North America and the Andes of South America, but a few are also found in the Alpine regions of India, the Malay Archipelago, Australia, and New Zealand, and one grows in Japan.

In this genus the calyx increases after flowering, and becomes fleshy round the capsule. The corolla is five-lobed. There are ten stamens, two-awned at the back. The capsule is loculicidally five-valved.

GAULTHE'RIC ACID, Methyl-salicylic Acid, is obtained from the oil of winter-green (*Gaultheria procumbens*, natural order Ericaceæ). The oil is obtained from the leaves by distillation with water. It consists principally of this acid, with a small quantity of a hydrocarbon called gaultherilene. The formula is $C_8H_8O_3$. It is a colourless liquid, boiling at 222° C. (431° Fahr.) It is a fragrant body, much used for scenting soaps.

GAUNT'LET, a large iron glove, with fingers covered with small plates, formerly worn by cavaliers armed at all points, and which used to be thrown down in token of challenge.

GAUR (*Bos* or *Bibos gaurus*) is a species of wild cattle (BOVIDÆ) inhabiting the mountainous districts of Central India. The gaur is a large and bulky animal, standing 6 feet high at the shoulder. A ridge runs along the middle of the back, which is strongly arched. There is no dewlap. The horns are short and strong. In colour it is a dark glossy brownish-black. The gaur occurs in herds of from twenty to thirty and upwards, feeding on leaves and tender shrubs. This animal is the bison of Anglo-Indian sportsmen. It is a formidable opponent in combat, and is said to be more than a match for the tiger. It is intolerant of captivity, and all efforts to domesticate it have been fruitless.

GAUR or **LAKHNAUTI**, a ruined city and the ancient capital of Bengal, is situated on a deserted channel of the Ganges, in 24° 52′ N. lat., 88° 10. E. lon. The time of the foundation of the city is involved in utter obscurity, and the whole course of its history, down to the day when it was finally deserted, is only to be vaguely conjectured. With regard to its origin it is known that it was the metropolis of Bengal under its Hindu kings. Local traditions connect some of its ruins with the oft-recurring names of Adisur, Ballal Sen, and Lakshman. The most ancient name for the city itself seems to have been Lakshmanawati, corrupted into Lakhnauti. The name Gaur is also of great antiquity, but it is probable that this name was more strictly applicable to the kingdom than to the city. The ascertained history of Gaur begins with its conquest in 1204 by the Mohammedans, who retained it as the chief seat of their power in Bengal for more than three centuries. This was the period during which were erected the numerous mosques and other Mohammedan buildings, which yet remain in a tolerable state of preservation. When the Afghan kings of Bengal established their independence they transferred the seat of government to Panduah, and in order to build the public structures of their new capital, plundered Gaur of every monument that could be removed. Hence it is that while the ruins of Panduah are covered with stones bearing Hindu sculptures, scarcely a single relic has been found on the site of

Gaur that could be definitely referred to a Hindu building. Panduah was soon afterwards deserted and the royal residence retransferred to Gaur, which continued, under the name of Janatabad, to be the capital of Bengal so long as its Mohammedan kings retained their independence. During the latter years of the Afghan dynasty the seat of government was removed to Tandan or Tagra, in the same district, but Gaur preserved the wealth and populousness of a great metropolis, until it finally disappeared from history at the time when Akbar's generals reconquered Bengal. During these last years of its greatness it suffered many vicissitudes. It was plundered by its own kings, repeatedly besieged, and more than once taken by storm. The city, with its suburbs, covered an area variously estimated at from 20 to 30 square miles. The situation is somewhat elevated, and the soil is clay, well suited to preserve the houses from inundations.

GAUSS, a practical unit of magnetic field often used by electricians, and named after the distinguished electrician, like the "ampère," the "weber," &c. The absolute unit of magnetic field is that where a wire one centimetre long, moving at right angles to the lines of force, with a velocity of one centimetre per second, should have an electromotive force of one volt induced between its ends. The "gauss" is one ten-millionth (10^{-7}) of the above unit, which is too large for practical use. The field of an ordinary Gramme machine varies in strength from 150 to 800 gausses.

GAUSS, KARL FRIEDRICH, whom Laplace considered the greatest mathematician of his time, and whose services to other sciences were so splendid that in one of them (magneto-electricity) the unit standard of the magnetic field has been named after him, was almost a typical man of science in his devotion to his work. Born of poor parentage at Brunswick, 23rd April, 1777, he soon showed immense ability, and was assisted by the Duke of Brunswick to a university education. In 1795 he began a brilliant career at Göttingen, which ended in the publication of his famous "Arithmetical Disquisitions" in 1801. His appointment to the observatory at Göttingen followed in 1807; and after this till his death in 1855 he was never absent one single night, it is believed, from his post. Yet the work this recluse accomplished was not without great practical effect, though it is true this required time to show itself. Apart from purely mathematical work of the most abstruse order, his calculation of the orbits of the asteroids and his general "Theory of Motions of the Heavenly Bodies" (1809), which gives one of the best practical methods of calculating planetary orbits, were of the highest value, and richly merited the Lalande gold medal which the Institute of France sent him in 1810. As a return he sent the prediction, accurately verified in time, of the comet of 1811. Unceasing work at his observatory was broken into in 1821 by his co-operation in the united Danish and Hanoverian state measurements of an arc of the globe, and of the triangulation of those countries—a work running over ten years. The results were two fine treatises by Gauss on the "Higher Geodesy," respectively appearing in 1843 and 1846. Among other brilliant inventions to facilitate the work Gauss invented the heliostat or flashing signal, which, after undergoing some further improvements, is to this day of priceless value not only in geodesy but in the military art. In 1831 Gauss made the acquaintance of W. E. Weber, the electrician (after whom the *weber* practical electrical unit is named), and his wonderful practical genius saw before it a fresh and untried field for discovery, into which he plunged with characteristic ardour. In 1833, with Weber's help, he arranged an observatory free from iron, specially for researches into magnetism; and here he made rapid strides in discovery. In a short time he set at work an electro-magnetic telegraph and founded the great Magnetic Association of Germany, taking simultaneous observations from Holland to Sicily upon a given plan. His splendid "Theory of Terrestrial Magnetism" appeared in the journal of this association in 1838. It is to Gauss that we owe the invention of the magnetometer, by which at once magnetism was made an exact science. In fact he may be regarded as founding the truly scientific study of magnetism, and his methods and instruments are those which still dominate this branch of science. In celebrating the centenary of his birth in 1877 the Brunswickers honoured themselves as well as their illustrious fellow-townsman. The essays and papers of Gauss are very numerous; only a few of his larger works have been mentioned above. He was a very cultivated man even outside his own scientific work, and was a member of all the learned societies of Europe. His industry was prodigious, and he was universally respected.

GAUTIER, THÉOPHILE (1811–1872), was born at Tarbes, in Gascony. As a master of that wonderfully keen literary weapon, modern French, in poetry, criticism, travels, and romance, he had few equals. He was intended to be an artist, but soon threw aside the pencil for the pen at Paris. He enlisted himself as secretary to the novelist Balzac. In 1830 his famous "Mdlle. de Maupin" at once marked him out for distinction. Unfortunately journalism engaged most of his energies; but his "literary baggage" is notwithstanding by no means light. As to its quality it is almost perfect as to form. The poems called "Emaux et Camées" are marvels of their kind. The novels of "La Momie," "Le Capitaine Fracasse," "La Morte Amoureuse," &c., are almost too carefully polished for these later days of novel-readers. A remarkable series of studies on peculiar men of the seventeenth century, "Les Grotesques," is one of his most admired works. His style, though ornate, is never overburdened, and his lightest essays bear frequent reperusal for the exquisite delicacy of the work. Delicacy in another sense he occasionally lacks

GAUZE, a light transparent cloth made of fine silken threads. The texture is different from that of plain weaving, in which the warp, or longitudinal threads, are always parallel to each other. The essential character of gauze-weaving is, that between each cast of the shuttle a crossing of the warp threads shall ensue, and thus the weft (which forms the cross-threads interlaced by the warp) is not brought into absolute contact with the cross-thread immediately preceding. The intervals left between the interlacings cause that degree of transparency which, without such arrangement, could only result from a looseness of texture incompatible with beauty and utility. It is supposed to have been first manufactured at Gaza in Palestine, hence its name.

GAV'ELKIND, a customary tenure chiefly found in the county of Kent. It seems that this tenure was the common socage tenure among the Anglo-Saxons, and the reason of its continuance in Kent has been ascribed to the resistance which the inhabitants of that county made to the Norman invaders. This tenure also prevailed in Wales until the 34 Henry VIII., when it was abolished by statute. The etymology of the word is doubtful. The distinguishing properties of this tenure are—that upon the death of the owner without a will the land descends to all the sons in equal shares, and the issue of a deceased son, whether male or female, inherit his part; in default of sons, the land descends in equal shares to the daughters; in default of lineal heirs, the land goes to the brothers of the last holder; and in default of brothers, to their respective issue.

The husband is tenant by courtesy of a moiety of his wife's lands, though having no issue by her; but if, not having issue, he marries again he forfeits his courtesy. A wife is endowed of a moiety of the lands of which her husband died seised, during chaste widowhood only.

Several statutes have been passed, at the request of

holders of gavelkind lands, to render them descendible according to the course of the common law, or, as it is called, to disgavel them. These statutes, however, only alter the partible quality of the customary descent; they do not affect the other incidents to the tenure.

GA'VIAL is the name of a family (Gavialidæ) of CROCODILES. The gavials differ from the true crocodiles (Crocodilidæ) in having the jaws very long and very narrow—so much so that they form a kind of subcylindrical beak that offers a strong contrast to the size of the head. At the end of the beak, where the nostrils are placed, the male has a large swelling of an oval form and cartilaginous structure, forming a kind of sac or nasal pouch, which is divided into two internally by a partition. The teeth are not so unequal in size and length as in the crocodiles, but are much more numerous. In general they are from 118 to 120 in number, and are all tolerably equal, with the exception of the five or six first pairs in both jaws. The canines are small, quite anterior, and those of the lower jaw fit into a notch in the edge of the upper.

The gavial of the Ganges (*Gavialis gangeticus*) is a native of India, more particularly of the Ganges, and is one of the largest species of the order of reptiles to which it belongs. It is about 17 feet long, and sometimes exceeds that length. The gavial feeds on fish chiefly, and notwithstanding its large size does not appear to be dangerous to man. It seems to have been known to the ancients, as Ælian speaks of a species of crocodile being found on the banks of the Ganges which had a kind of horn on the snout. It is more aquatic in its habits than the crocodile, and is seldom seen out of the water. Another gavial inhabits Borneo and some of the surrounding islands. It has a more conical beak than the Gangetic gavial, and the teeth are less numerous. It has been described under the name *Tomistoma schlegelii*. The gavial of the Ganges is figured in the Plate CROCODILIA, prefixed to vol. iv. of this work.

GAVOTTE (or in English spelling, *gavot*) is the name of a dance, "a brisk round for as many as will," a sort of lively, dignified country dance. Littré, in his French Dictionary, calls it a *danse grave*, but says it differed from other "grave dances" in abandoning the shuffling of the feet along the floor for a stately step. The rhythm is marked and the measure 4-4 time; the parts are usually of eight bars each, and each part is repeated. The piece should properly begin on the third beat of the bar, and each part should finish with a minim; these rules, often not observed, giving a highly characteristic effect to the dance. Consequently it was a great favourite with the composers of instrumental "suites," who used it as a "form" in the manner in which Haydn and Mozart used the form of the minuet in their symphonies. The gavottes of Bach and Handel are particularly fine, and are still very favourite compositions with pianists. The gavotte died out in the middle of the eighteenth century. Lately a foolish revival of the gavotte took place, and for a few years the public was pestered with worthless modern imitations of a noble antique form.

GAY, JOHN, born at or near Barnstaple, in Devonshire, in 1688, began the world as an apprentice to a mercer in London. That employment, however, he soon forsook, and published his first piece, "Wine," in 1710; it was followed in 1713 by "Rural Sports," which he dedicated to Pope, and thus established an acquaintance which ripened into a firm and lasting friendship. In 1712 he became secretary to the Duchess of Monmouth, whose service 1 quitted in 1714 to attend the Earl of Clarendon, ambassador to Hanover, in a similar capacity. This was his introduction to a court life. He sought and obtained the favour of the Prince of Wales, but was neglected after that prince's accession to the throne; and he suffered much from the disappointment. The later years of his life were spent in the household of the Duke of Queensberry, where he was treated with great kindness and respect. He died 4th December, 1732, and was buried in Westminster Abbey, where a monument, with an affectionate inscription by Pope, is erected to him.

Gay wrote several comedies and farces, of which we need only mention the celebrated "Beggar's Opera," which was produced in 1727, and was acted for sixty-three following days during that season, besides obtaining similar popularity in other places. His other chief works are the "Fables," the "Shepherd's Week," and "Trivia, or the Art of Walking the Streets of London." Of his minor poems, the favourite ballad of "Black-eyed Susan" is a good specimen.

GAYAL (*Bos* or *Bibos frontalis*) is a species of wild cattle, a member of the family BOVIDÆ. It inhabits the mountainous districts of North-eastern India. It is capable of domestication, and large herds of these cattle are kept by the native tribes, especially in the district of Chittagong. The gayal is about the size of a large bullock. The horns are short and thick, flattened from before backwards, and directed outwards with a slight inclination upwards. A strong ridge runs along the middle of the back, a small dewlap is present, and the tail is short. The coat exhibits a blackish-brown colour generally. The gayal feeds on shoots and leaves of shrubs. The bull is very bold, and will defend himself against any of the beasts of prey. The gayal thrives in captivity, breeding freely with different species of cattle.

GAY-LUSSAC, LOUIS JOSEPH, a celebrated French chemist and physicist, was born 6th December, 1778, at St. Léonard, in the department of Haute Vienne, where his father was procureur-royal. Berthollet, who, as professor of chemistry at the École Polytechnique, had become acquainted with Gay-Lussac while a student in that institution, and had made several experiments with him, appointed him demonstrator to his class, and shortly afterwards employed him at his estate at Arcueil, where he was working at his "Statique Chimique." Gay-Lussac now devoted himself entirely to the pursuit of physics and chemistry, which had lately received a fresh impulse from the labours of Dalton (1801). In 1805 he became a member of the consulting committee of arts and manufactures, and in 1808 he married. In 1809 he was elected professor of chemistry at the École Polytechnique, and also obtained the chair of physics at the Sorbonne, which he filled from 1808 to 1832. He was chosen professor of general chemistry at the Jardin des Plantes in 1832. In 1829 he became a member of the council for improving gunpowder and saltpetre, and was attached to the mint. In 1831 he was chosen deputy for the first time, and was afterwards several times re-elected; and in 1839 was created a peer. He died of atrophy of the heart, 9th May, 1850, at Paris.

His first work on the expansion of gases and vapours was published in 1801 (*Ann. Chim.* xl. 137), and was followed by papers on the tension of vapours, evaporation, &c. He next turned his attention to the investigation and perfection of thermometric, barometric, and hygrometric instruments, and to capillary attraction. In 1804 he applied to M. Chaptal, minister of the interior, for aid in a balloon ascent which he contemplated to ascertain whether the terrestrial magnetism ceased out of contact with the earth. In the same year he undertook a second ascent, and reached the hitherto unattained height of 7000 metres (nearly 4½ miles). The results of his research on the coefficient of expansion of the permanent gases, though more accurate than those of Dalton, were not perfectly correct, but from the improved method of determination introduced were of the highest importance. In 1804 he was chosen a member of the Society of Arcueil, which had been formed by La Place and Berthollet, and

consisted of only nine members. Between 1804 and 1805 he made some eudiometric researches with Humboldt. He discovered that 100 volumes of oxygen combine with as nearly as possible 200 volumes of hydrogen to form water; and this led him to the conclusion that the relation was 1 : 2, and that a simple law analogous to that discovered by Dalton for combination by weight also governed combination by volume. In 1808 he ventured to publish his results, laying down the law that "when two gases combine, their volumes bear a simple numerical relation to one another, and the volume of a common product in the gaseous form likewise bears a simple relation to the sum of volumes of the gases which have entered into the combination." In 1811, with Thénard, he succeeded in preparing sodium and potassium in considerable quantities by reducing their oxides with redhot iron. They were then enabled to try the action of these metals on various other bodies, and made various important discoveries, reducing boron from boracic acid, &c. Gay-Lussac also made numerous discoveries in organic chemistry, and first prepared pure liquid hydrocyanic (prussic) acid. In 1815 he published his celebrated work on cyanogen, and showed that prussic acid is the hydracid of cyanogen, which may be regarded as a *compound radical* playing the part of a simple body. For many years, in conjunction with Arago, Gay-Lussac was editor of the *Annales de Chimie et de Physique*, one of the most important scientific publications of France.

GAY-LUSSITE (in honour of the French chemist Gay-Lussac) is a hydrated carbonate of lime and soda that occurs in detached oblique rhombic prisms and aggregate crystals, found in some saliferous deposits; it also occurs on the margins of some of the soda lakes of North America, and pseudomorphs after this mineral are not uncommon in the calcareous tufa of these dried-up lakes. It has a hardness of 2 or 3, and a specific gravity of about 2.

GAZA or **GHAZZEH**, a town in the south-west of Palestine, near the borders of the desert which separates it from Egypt. It consists of the upper town, with a castle, situated on a hill, about 2 miles from the sea, and a lower part in the valley. The population is about 16,000. Gaza is greatly fallen from its ancient splendour, but it still exhibits signs of commercial activity and prosperity. It is repeatedly mentioned in the Bible, especially in Judges (chap. xvi.), as one of the principal towns of the Philistines. It was taken by Alexander the Great after an obstinate defence. The hill upon which Gaza stands is about 2 miles in circumference at the base, and appears to have been once wholly inclosed by walls. The modern town being surrounded by gardens and plantations of olive and date trees, above which numerous and elegant minarets rise, has a pleasing appearance from a distance. It has several bazaars, manufactories of soap, and a good trade in corn, besides being a principal entrepôt for the caravans passing between Egypt and Syria. The word Gaza signifies "the strong."

GAZELLE is the name given to a group of ANTELOPES, celebrated from ancient times for the beauty of their form, the grace and elegance of their movement, and the gentleness of their manners. The gazelles form the genus Gazella, and twenty species have been described. They are confined to Africa, Arabia, Persia, India, and Central Asia. The horns are usually common to both sexes. In the males they are more or less compressed on the sides, transversely ringed nearly to the tips, and lyrated, or with a double curvature, first backwards at the base, and afterwards pointing slightly forwards. In the females they are straighter and more slender. The gazelle *par excellence* is the *Gazella dorcas*, the roe or roebuck of the Bible. This beautiful animal, which is a native of North-eastern Africa and Syria, stands less than 2 feet high at the withers, and is furnished with a pair of strong ringed horns about 10 inches in length. The ears are conspicuous and sharply pointed. The fur is more or less fawn-coloured or tawny, but varies according to age; the breast and abdomen are white. The habits of the gazelle are gregarious. Considering their slender build these animals are remarkably courageous, and will unite to defend themselves against the strongest Carnivora, although they usually fall victims to these overpowering enemies.

The full, lustrous, black eyes of the gazelle have been sung of both by Jewish and Arabian poets. Beautiful women in the East are compared to gazelles. The Hebrew name for gazelle signifies "beauty." The Arabian gazelle (*Gazella arabica*) is also found in Palestine. It is very similar to the Dorcas gazelle, but its fur is of a darker colour, and its horns are not lyre-shaped.

GAZETTE (*gazetta* in Italian, *gaceta* in Spanish) is the name given to newspapers in several parts of the Continent. This name was, according to Ménage and others, derived from a small Italian coin, which was the price for reading the first newspaper established in that country. The first gazette in England was published at Oxford in 1665. On the removal of the court to London, the title was changed to the *London Gazette*. It is now the official newspaper, and is published on Tuesdays and Fridays. There are also gazettes published weekly in Dublin and Edinburgh, which are likewise the official newspapers for their respective countries. *Gazetteer* has been used in England to signify a geographical dictionary and other similar works.

GE (the *g* sounded hard, as in *get*). See GÆA.

GEARING, in its most comprehensive sense, means any train of mechanism whereby motion is transmitted from one moving piece in a machine to another. In a more limited sense, it is applied to the contrivances whereby one wheel gives motion to another, and is then distinguished into *toothed gearing*, in which motion is transmitted by means of teeth or cogs; *screw gearing*, where spiral projections, or screw-threads, are used instead of teeth; *chain gearing*, in which an endless chain is used to transmit the motion; and *frictional gearing*, in which each wheel has several V-shaped grooves going round its rim, and motion is transmitted by means of the mutual friction of the groove surfaces of a pair of wheels pressed together with sufficient force.

GEAS'TER is a genus of FUNGI, nearly allied to the puff-balls. The outer coat is distinct from the inner, and at length splits into lobes, and separates from the inner, forming a kind of star, whence the common name "earth-star" (Ge-aster). The inner coat incloses the spore-bearing

Fig. 1. Fig. 2.

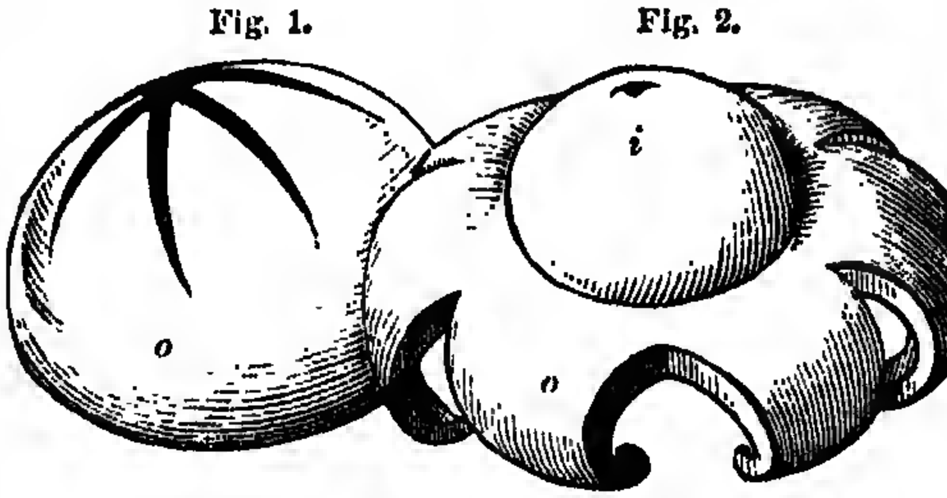


Fig. 1, Outer peridium, *o*, splitting into lobes. Fig. 2, Inner peridium, *i*, surrounded by outer, *o*, which has expanded.

surface (hymenium). The inner portion dries up into a mass of threads and spores. Geaster belongs to the order of GASTEROMYCETES.

GE'BANG PALM (*Corypha Gebanga*) is a fan-leaved palm, a native of the East Indies. The leaves are very useful, and numbers of people are employed in Java in making them into bags, baskets, hats, thatch, and in manufacturing their fibre into shirts, fishing-nets, cordage,

and ropes. The pith of the trunk affords a kind of sago. The root is somewhat astringent, and is useful in the periodical diarrhœas to which Europeans are subject in the tropics. For other species, consult the article CORYPHA.

GE'BIR, a celebrated alchemist, generally supposed to have been an Arabian, whose proper name was Abu-Mussah-Jaafer Al-Sofi, and who flourished about the eighth century, but with respect to whose history there is great uncertainty. The writings under his name were very numerous, and formed the chief authorities for alchemists up to the beginning of the sixteenth century. Those still existing are marked by a clearness and style so different from anything known to have been produced on this subject at or before that time, that it is difficult to explain their existence on any reasonable theory.

GECAR'CINUS. See LAND-CRABS.

GECK'O is the name of a family of lizards, Geckotidæ, having almost a world-wide distribution, inhabiting the warmer regions of both hemispheres, and being found even in the remotest oceanic islands. In these lizards the head is broad and flattened, with the mouth wide; the nostrils are distinct and lateral; the eyes large, hardly surrounded by short lids, the lower edge of which in the greater number of species does not project outwards, the pupil sometimes rounded, but most frequently dentilated, linear, and lightly fringed; and the auditory opening bordered with two folds of the skin. The teeth are small, equal, compressed, sharp at the point, entire, and planted in the internal edge of the jaws; there are none on the palate. The tongue is short, fleshy, capable of but little elongation, and free at its extremity, which is either rounded or flattened, or very slightly notched.

Their neck is apparently little, in consequence of the width of the back part of the head and squareness of the shoulders. Their body is thick and short, depressed, and low on the legs, with a belly flat below, dragging on the ground, and largest in the middle. There is no crest on the back. The tail varies, but is not long, and often has folds or circular depressions, but never a dorsal crest.

The feet are short, nearly equal in length, wide apart, and robust; the toes nearly equally long, flattened out into broad discs, and furnished with transverse imbricated plates; the nails vary, but they are ordinarily hooked, sharp, and retractile.

The skin is defended by equal granular scales, most frequently interspersed with other tubercular scales, the points blunt or angular. There are femoral pores or pores in front of the vent, on the same line, in the majority of species, and most frequently in the males only. The limbs and sides are sometimes bordered with fringed membranes.

The geckos are none of them large in size, and the greatest number feed on small animals, such as insects, their larvæ and pupæ. These they catch either by lying in ambush or by pursuing their feeble prey in the holes and dark crevices to which it retires. The structure of their feet enables them to run in every direction over the smoothest surfaces, and they can even remain suspended beneath the large leaves which a luxuriant tropical vegetation so frequently puts forth. Their sharp nails enable them to cling to and make rapid progress on trees with the smoothest bark, to penetrate the holes of rocks, and to climb walls. Of sombre or varying colours, adapted generally to the locality where their lot is cast, they will often remain for hours in positions as extraordinary as the flies and insects for which they watch. The hues of their skins thus render them less objects of suspicion to the little animals for which they lie in wait, and also serve to dodge even the acute eye of the bird of prey that seeks to destroy them. Their eyes are so formed as to enable them to discern objects in the dark, and are at the same time capable of bearing the rays of a bright sun; for many insects are nocturnal or crepuscular, while the great mass of them are diurnal. The pursuit of their prey leads them near the habitations of man, whose dwelling always attracts certain kinds of insects, and they sometimes fall victims to their appearance, which frequently inspires terror, and often disgust. A gecko, confident in his powers of flight, appears boldly to await his adversary, and his sudden disappearance at a nearer approach adds to the horror which his uncouth form inspires. The poor geckos, too, have a bad name. They are supposed to poison whatsoever they touch, be it animate or inanimate, and their saliva is said to vex the skin of those on whom it falls with foul eruptions. Many of those cuticular irritations, when they have actually existed from the intervention of these animals, may have arisen from the extremely sharp claws of a gecko running over a sleeping man, or small blisters may have been raised by the adherent apparatus at the bottom of its feet.

The species of geckos are numerous, about 200 having been described. Some are so far domestic as to live in houses; others are wilder, and live in sandy desert places; while a third set live in a great measure on trees, and chase their prey by springing from branch to branch. The name of gecko is derived from the peculiar noise they make, which is like the sort of sound by which horses are urged to greater speed.

The Warty Gecko (*Hemidactylus verruculatus*) is one of the few geckos found in Europe. It is a native of all the countries bordering upon the Mediterranean, and is found in Northern Africa, in the neighbourhood of Trebizond, in Greece, Sicily, Italy, Spain, and the south of France. It is of a grayish colour, marbled with brown. The toes are dilated only at the base, the two last joints being free. The House Gecko (*Ptyodactylus gecko*) abounds in Egypt, where it has received the name of *Abou-burs* (father of leprosy), from the belief that its poison produces this disease. The Flying Gecko (*Ptychozoon homalocephalum*) has lateral membranous expansions and webbed feet, which act as parachutes to assist its movements from one tree to another. Some geckos have the power of changing colour like the chameleon; some Indian species become luminous in the dark.

GEDDES, JENNY, the name of a Scottish stall-woman celebrated in history for her spirited resistance to the introduction of the liturgy into Scotland. The occasion arose in 1637, when through the intolerance of Archbishop Laud a service-book prepared by him was ordered to be read on Sunday, the 23rd July of that year, in St. Giles' Church, Edinburgh. The church was filled by an angry crowd of Presbyterians, and when the Dean of Edinburgh began to read, Jenny flung her stool at his head shouting, "Villain! dost thou say mass at my lug" (ear)? This act was the signal for a riot, before which both bishop and dean fled for their lives, and the tumult gave the deathblow to the liturgy in Scotland. An order indeed came from Charles to enforce the reception of the new prayers by the soldiers if necessary, but the Scottish spirit was now fully aroused, and by the February and March of the next year nineteen-twentieths of the nation signed the National Covenant, by which they bound themselves to oppose the revival of Roman Catholicism in Scotland and to defend their freedom and laws. Like many another celebrated historical story, however, the anecdote of Jenny Geddes has been doubted and denied, while the fame of the act has been claimed for another person, one Barbara Hamilton. A wooden stool reputed to be that which was thrown is preserved in the museum of the Society of Antiquaries at Edinburgh, but its genuineness is also open to doubt.

GEELONG' was for some time the second town in Victoria, Australia, but Ballarat has now dispossessed it of its pre-eminence in this respect. It is 45 miles S.W. of Melbourne, at the head of a deep inlet on the west side of

Port Philip. The harbour is large and sheltered; the bar at its entrance has been dredged, so that there is now sufficient depth for large ships to enter. The inner harbour is called Corio Bay, from a native name. The town is favourably situated for health and good drainage, and an immense sum has been laid out on the improvement of the streets and other public works. There is a reservoir capable of containing 1,000,000,000 gallons of water. It has daily newspapers and numerous other publications. Corio Bay is so well sheltered that four capacious bathing establishments have been erected, which are well supported. There are also three jetties, alongside which ships of large tonnage can load and discharge. The depth of water over the bar at the entrance is now 21 feet. The town has the credit of establishing the first woollen mill in Victoria, and received a government award of £1500 for so doing, and the industry is still very prosperously carried on. One of the largest tanneries in the colony is situated on the river Barwon. Large quantities of wool are shipped from Geelong to England. There are extensive quarries of limestone at the eastern boundary of the town, on the shores of Corio Bay. The country around is essentially agricultural, and is taken up by farms, vineyards, and orchards. The population is 21,000.

GEHEN'NA is the Greek form of the Hebrew Gehinnom, the valley of Hinnom, or Ge-ben-Hinnom, the valley of the son or of the children of Hinnom. It is a deep narrow glen to the south of Jerusalem, having steep and rocky sides, the cliffs on the south side abounding in ancient tombs. It was here that Solomon erected an altar to Moloch (1 Kings xi. 7), and that Ahaz and Manasseh, after the introduction of the worship of the fire-gods, caused the offering up of young children as human sacrifices to these terrible deities. According to an ancient tradition the image of the god was made of metal, and a fire was kindled within it, the child sacrificed being laid upon the red-hot arms of the idol and its shrieks drowned by the noise of cymbals, drums, and the shouts of the worshippers. Jeremiah has several lengthy references to this place and the horrid rites practised there (Jer. vii. 31-33; xix. 5; and xxxii. 35). At a later period the valley was defiled and converted into a cesspool and laystall for the city of Jerusalem, and here the dead carcases of beasts and every offal and abomination were cast to be devoured by the worms or burned in large fires kept for this purpose. It is said these fires were attended by criminals and were kept constantly burning, hence the name Gehenna or Tophet came to be used by the Jews as symbolical of hell and torment. It is in this sense they are used in the New Testament, where the expression given in the book of Isaiah, chap. lxvi. 24, is repeatedly used to describe the place of future punishment. In many parts of the New Testament the word translated hell in the Authorized Version is literally Gehenna.

GEISSLER'S TUBES are tubes containing highly rarefied gases, invented by a Mr. Geissler. There are several varieties, called by an easy figure "vacuums;" thus we have the oxygen vacuum, the nitrogen vacuum, &c., meaning a tube once filled with oxygen, &c., but from which all the gas has been drawn that it is possible to extract. Of course it is well known that some small amount of the gas must remain in a highly rarefied state. The tubes are furnished at each end with a platinum wire passing through the glass. An electric discharge from an induction coil through such a tube will cause each gas to glow with a characteristic colour, and by suitably contracting the tube this glow may be intensified; also varieties of glass affect it. Beautiful stratifications are seen to cross the glowing gas. Each gas produces its own peculiar spectrum. Carbonic acid gas glows white with such intensity in a narrow spiral Geissler's tube, that it has been used as an illuminant by surgeons in examining inner parts of the human body. It is found that the light produced in these tubes is especially rich in those rays causing fluorescence and phosphorescence. Uranium glass is made to glow with a fine green light by fluorescence if it forms the material of a Geissler's tube; and quinine or other fluorescent liquids receiving the light from these tubes may be similarly affected with ease. The experiments are all of the highest beauty.

The rarefied gas itself is a conductor, and its presence is essential to the passage of the electric current. When it is absorbed by chemical means, such as fused caustic potash in the case of a carbonic acid vacuum, the resistance of the tube rapidly increases, and the current may altogether cease to pass, at once recommencing when, by heating the caustic potash, carbonic acid gas is again liberated.

GE'LA, a Grecian colony on the south-western coast of Sicily, was founded by a joint colony from Crete and from Lindus, a city in Rhodes, forty-five years after the foundation of Syracuse (Herod. vii. 153; Thuc. vi. 4). Gela was one of the most powerful of the Grecian colonies in Sicily, and continued so to the time of Gelon, who, having conquered Syracuse, removed the government to the latter town. The modern town of Terra Nova is supposed to have been built upon its site.

GELA'DA (*Cynocephalus gelada*) is a species of BABOON inhabiting Abyssinia. The gelada differs from nearly all the other baboons in having its nostrils opening high up in the face instead of at the end of the produced muzzle, like a dog. The upper part of the body is covered with very long hair of a pale brown colour. The limbs are black. The tail is long and tufted at the end. In its habits it resembles the other baboons.

GELA'SIUS I. succeeded Felix II. as bishop of Rome in 492. He died in 496, and was succeeded by Anastasius II. He took an active part in the conflict with the patriarch of the Greek Church, each excommunicating the other.

GELASIUS II., a Benedictine monk, succeeded Paschal II. in 1118. The popes were then at open war with the emperors of Germany; and the partisans of the latter at Rome, headed by the powerful family of Frangipani, opposed the election of Gelasius, and afterwards seized him and personally ill-treated him, until he was rescued from their hands by the Prefect of Rome. Soon after the Emperor Henry V. came himself with troops, and the pope having run away to Gaëta, an antipope was elected by the imperial party, who styled himself Gregory VIII. After a few months Gelasius entered Rome under the protection of the Norman Duke of Apulia; but venturing out of quarters to celebrate mass he was attacked by the Frangipani, and only escaped from the street-fighting which ensued by a furious gallop on horseback, without staying to disencumber himself of his sacred vestments. He left Italy for France, and died at the convent of Cluny, in January, 1119, and was succeeded by Calixtus II.

GEL'ATIN. This substance is obtained from bones or from animal membranes by boiling in water; on cooling the solution gelatinizes or forms a jelly, which, when dried, becomes gelatin, size, or glue, according to the source from which it is derived. When bone is acted on by a strong acid the phosphate and carbonate of lime are dissolved out, and the gelatin remains. The skin, tendons, horns, and hoofs of animals all contain this substance. A very pure variety is obtained from the swimming-bladder of the sturgeon, and is called isinglass. Gelatin is insoluble in cold water, but it swells up and absorbs about 40 per cent. by weight, and becomes translucent. It occurs generally in thin, elastic, brittle plates. For the coarser varieties of glue all sorts of animal membranes, especially clippings of hides, are used, but for the best gelatin for dietetic purposes calves' heads and feet are mostly employed. Great care is necessary in the manufacture; prolonging the boiling

must be avoided, as it causes the loss of the power of gelatinizing. Alcohol precipitates the jelly. Gelatin gives a precipitate also with tannin, which is the foundation of the art of making leather. Gelatin in the form of jelly rapidly putrefies. It usually contains 0·12 to 0·14 of sulphur. The following analyses show the composition of gelatin from different sources:—

	Bone.	Horn.	Cartilage.	Isinglass.
Carbon, . .	50·0	49·4	49·81	50·1
Hydrogen, .	6·5	6·6	7·14	6·6
Nitrogen, .	17·5	18·4	17·38	18·3
Oxygen, . .	26·0	25·6	25·67	25·0
	100·0	100·0	100·00	100·0

In addition to the extensive use of gelatin as an article of food in the form of jellies, it is largely employed as a size for fabrics and for paper. It is the basis of some of the most recent photographic processes, and is rapidly taking the place of collodion as a vehicle for the sensitive salts of silver. When combined with the dichromates of the alkalies it is rendered insoluble by the action of light, and this circumstance is utilized in various photographic printing processes. See PHOTOGRAPHY.

It is not probable that gelatin exists as such in the body any more than fibrin, and for the same reasons; but the elements of gelatin, and its close allies chondrin, mucin, elastin, and keratin (obtained respectively from cartilage, mucus, elastic tissue, and the hair and nails), form a very considerable part of the body of all animals. It represents almost the whole substance of certain parts, especially of the air-bladder of fishes. Gelatin and the other kindred bodies named above, though nitrogenous foods, are yet so very distinct from ordinary proteids that when used as food *by themselves* they are entirely unable to support life. [See FOOD.] In combination with other proteids they are, however, valuable. Gelatin, indeed, is esteemed very highly as a food in the East, and it forms the chief ingredient in the soups and stews made from the edible birds' nests, sharks' fins, fish maws, ray skins, &c., which are so greatly prized by the Chinese, Japanese, and Siamese. With ourselves it forms the basis of many soups, as when the careful housewife boils the waste bones for stock; but either fresh meat or vegetables should be added to it.

GELD (Saxon *gild*, or Danish *gield*, tribute money), a term used by our Anglo-Saxon ancestors to signify money or tribute, being a fine or compensation for a public wrong. Thus *wergild* was compensation for a man's life, and *orfgeld* the value of a beast slain. *Angeld* was the single value of a thing, and *twigeld* the double value. *Danegeld* was a tax imposed to raise means against the Danes.

GEL'LERT, CHRISTIAN FURCHTEGOTT, born near Chemnitz, in Saxony, acquired a great reputation as a writer of fables and as a moralist. He also wrote "Sacred Odes and Songs," and his "Letters" have been published. He wrote, fortunately for himself, just as the reign of the pedantic Gottsched was closing. The freshness of his style at once gave him fame. Gellert died at Leipzig, where he was professor of belles lettres and philosophy, in December, 1769, and a monument was raised to him in the Church of St. John.

GEL'LIUS, AULUS. See AULUS GELLIUS.

GE'LON, a native of Gela, rose from the station of a private citizen to be ruler of Gela and Syracuse. During the reign of Hippocrates at Gela (B.C. 498–491) Gelon was appointed commander of the cavalry, and distinguished himself in the wars of Hippocrates against the Grecian cities in Sicily. On the death of Hippocrates, who fell in a battle against the Siceli, Gelon seized the supreme power (B.C. 491). Having become master of Syracuse at the invitation of the nobles, then in conflict with the common people, he appointed his brother Hieron governor of Gela. In order to increase the population of Syracuse, he destroyed Camarina and removed its inhabitants, together with a great number of the citizens of Gela, to his favourite city. As he was indebted for his power in Syracuse to the aristocratical party, he took care to strengthen it against the people. At the time of the invasion of Xerxes Gelon would have assisted the Greeks if he had not been prevented by an invasion of 300,000 Carthaginians under Hamilcar. This great army was defeated near Himera by Gelon (B.C. 480), on the same day on which the battle of Salamis was fought. Gelon died, universally regretted, B.C. 478; and the Syracusans honoured him with a splendid tomb and the reverence due to a demigod.

Gelon appears to have used his power with moderation, and to have endeared himself to the Syracusans by the

Coin of Gelon in the British Museum—actual size (silver); weight, 98 grains.

equity of his government and the encouragement which he gave to commerce and the fine arts. There are still existing many coins of Gelon and his brother and successor Hieron, of beautiful workmanship.

GELOSE, a strongly gelatinous principle imported from China and Japan under the name of Japanese isinglass. It is obtained from an alga (the *Gelideum corneum*), which contains 50 per cent. of it. It has eight times the gelatinizing power of the best isinglass or gelatin. The jelly, however, has too high a melting-point to melt quickly in the mouth, and therefore has never superseded gelatin for domestic use, although it has been imported since 1856. Moreover it contains no nitrogen. It will yield a jelly with 500 times its weight of water, and the jelly does not readily putrefy. It is insoluble in cold water, but very soluble in boiling, the solution on cooling yielding a very stiff jelly. It is a good deal used in sizing fabrics. It contains, carbon 42·8, hydrogen 8·8, oxygen 51·4. It resembles caragheenin.

GELSEM'INUM (*Gelseminum sempervirens*), the yellow jessamine or field jessamine, is one of the most beautiful climbing plants of the Southern States of America. It belongs to the Loganiaceæ family, and is not in any way related to the garden jessamine of England. It is cultivated in America as a garden plant on account of its power of shade, and for the beauty and perfume of its blossoms. The root is used in medicine chiefly in the form of a tincture, which is composed of one part of the plant to four of rectified spirit. It is sometimes substituted for aconite in the treatment of fever, and is said to be specially useful in cases of the simple fever of childhood. It has also a high reputation for the alleviation of neuralgia of the jaw, especially that which is caused by the presence of decayed teeth. For the latter complaint the dose is from five to ten drops of the tincture in a wineglass of water every three hours. If taken in too large doses, or continued too long, it is apt to cause headache, giddiness, and double vision; but these symptoms are temporary and cease when the medicine is discontinued.

GEM'INI (the Twins), the third constellation in the Zodiac, occupying the region of the heavens represented by the *sign* Cancer. The Greeks refer it not only to the fable of Castor and Pollux, but also to those of Hercules

and Apollo, Triptolemus and Iasion, Amphion and Zethus, &c. This constellation derives its name from two remarkable stars of the first magnitude, to which the names of Castor (or Apollo, or α Geminorum) and Pollux (or Hercules, or β Geminorum) are given. Castor is one of the finest double stars in the sky; Pollux is a coarse quadruple star, rather excelling Castor in lustre. These two stars, whose proximity will cause them to be easily recognized when once known, may be found by drawing a line through the belt of Orion and the two bright stars, the line of which cuts through the belt. This line, lengthened upwards, will pass very near to the two stars of Gemini. They are also about halfway between Regulus and Aldebaran; and if the Great Bear and Orion be seen together, then Capella on the one side, and Castor and Pollux on the other, will be conspicuous boundaries of the intermediate space. The constellation Gemini is found in the Northern Hemisphere of the plate CONSTELLATIONS, on the ecliptic, just above the figure VII. The sign ♌ (Cancer) is seen upon the body of Castor. The sign II (Gemini) will be found in the constellation Taurus; the sun enters Gemini (the sign) about the 21st of May and leaves it about the 21st of June. As to the discrepancy between the place of the signs and of their constellations see ARIES.

GEMINIA'NI, FRANCESCO, was born at Lucca about the year 1680. The foundation of his musical knowledge was laid by Alessandro Scarlatti, but he completed his studies under Corelli. Geminiani arrived in London in 1714, where his performance on the violin speedily gave him celebrity. Although favoured by the court, his habits of extravagance kept him poor during the greater part of his life. He was a fair composer; but his claim to remembrance lies chiefly in his having been the first to publish a well reasoned violin school. This remarkable work appeared in 1740. Geminiani died at Dublin in 1762.

GEMOT' or **GEMOTE** simply means assembly or "meet" in the oldest English speech. It is more often written *mot* or *moot*. The great Anglo-Saxon Parliament was the *witenagemot*, or assembly of the witan or wise men; the *scirgemot* was the shire-mote or county court. Then there were the *hundred-mote* or divisional meeting, the *hallegemot* or manor court, the *tun-gemot* or *burygemot*, town mote, &c. We still use the phrase in the famous and historical *wardmotes* of London. These various meetings, of which there were more than it has been thought necessary to notice, all in their degree preserved that local spirit of independence dear to the Teutonic mind (so dear that one of the main divisions of their race had for their sole name *Franken*, the free men), since at the mote there was no distinction except that necessary for order, or that voluntarily given to age or to character. Without the sanction of the suitable gemot the executive, from the king down to the mayor, had no power to act for long together. Each gemot had its customary frequency of assembly. The principal varieties are described under their respective headings.

GEMS. The word gem, which has come to mean, in popular language, merely cut or uncut precious stones, such as diamonds, rubies, emeralds, &c., has by right an entirely different signification. However, the word having changed its meaning the change has been frankly accepted by mineralogists, and the scientific mineralogical meaning of the word gem is limited to a certain group or order of minerals containing the sapphire, ruby, emerald, topaz, jacinth, garnet, beryl or aquamarine, and a few others, as well as bodies mineralogically allied to them, though sometimes extremely different in appearance and uses. Thus the brilliant sapphire is but a variety of the dull corundum, one of whose forms is the common emery, all alike being nothing more than alumina, and alumina is one of the two main constituents of common clay (hydrated silicate of alumina). Corundum is therefore scientifically classed with the gems, in spite of its appearance and its humble relationship to mother earth; while the diamond, most precious of all stones is, as mere carbon, excluded from the class. The diamond, though not a gem scientifically, is the hardest known substance; and if its hardness be called ten, that of corundum is nine. In fact the general features of the group of gems are that they will scratch all substances not harder than quartz, will not melt in an ordinary blowpipe flame, nor dissolve in acids. With gems proper are coupled precious stones, such as cordierite, chrysolite, opal, chalcedony, onyx, sardonyx, agate, &c. The Plates accompanying this article represent some of the chief of these gems and stones. Amber, which is almost equally used with them for necklaces, bracelets, and other articles of jewelry, is also figured, though that is not a stone, but the fossil gum of an extinct coniferous tree. Jewellers also reckon pearls as gems by a similar misnomer. Of the rest, which are all fully described under their separate articles, the diamond is the crystalline form of pure carbon and is the most precious—all the large stones being Indian, the most valuable ordinary stones Brazilian, and a less precious variety being found in large numbers in South Africa, much mixed with garnets. The sapphire and the ruby come next the diamond in hardness and in value, being the blue and red variety of crystalline corundum, *i.e.* alumina; and alumina being, as said above, one of the two main constituents of common clay. Both are found in the finest form at Ceylon, usually mixed with garnets. Emeralds, which are the next precious, differ only in colour from the paler aquamarine or beryl, which varies from greenish-yellow to greenish-blue. Emeralds are chiefly silica (flint), with an admixture of alumina and other bodies; they therefore come more nearly to the composition of clay (silicate of alumina) than even the ruby and the sapphire. The topaz reverses these proportions, having far more alumina than silica in its constituents, and is consequently a rather harder stone than the emerald, though not so prized. The topazes of Brazil are the finest, while emeralds of the greatest beauty come rather from Santa Fé de Bogota. Topazes are found (rarely) in Scotland and Ireland; emeralds of an inferior quality in Salzburg (South Germany). Garnet of a common sort occurs frequently, and often in the massive form. All garnets are silicates, but their further composition is very various, and their colour equally so. The finest variety is the almandine, a ruby-red garnet, a silicate of iron and alumina; the hardest is the lime-iron, the black variety of which (found in Pegu) is the most precious. Amethyst (finest in Ceylon, India, and Brazil) is pure quartz coloured by a little peroxide of manganese. Agate and chalcedony are also simply quartz. Opal is practically pure hydrated silica. The finest opals come from Hungary. Turquoise, softer than quartz, is nearly pure phosphate of alumina coloured with copper; it is almost exclusively a Persian stone. Lapis-lazuli (probably the sapphiro of the ancients) is a silicate of aluminium, calcium, and sodium of a fine blue, scratching glass and bearing a fine polish. When burnt it yields the artist's ultramarine. It occurs like malachite in sufficient masses to be used in costly buildings. The best is found in Persia, China, and Siberia, and in the Andes.

But the artistic and antiquarian meaning of the word gem keeps to the older use. *Gemma* is undoubtedly *genima*, from *gen*—the Latin and Greek form of one of those ARYAN roots which permeate the speech of our half of mankind, viz. the form √GA, to beget—and the ordinary meaning of *gemma* is simply bud, the bud of a tree. And just as our *bud* (a thing budded or thrust out, as its etymology shows) gave rise to *button*, so did *gemma*, the bud, come to signify *gemma*, the bud-like carved ornament in hard stone. Hence by degrees any carved precious stone was called

a gem. The Greek word was *anaglyph* (*anaglupha*). The great use of antique gems was for signet-rings. The design was cut into the stone (intaglio) so that the impression on the wax, being of course reversed in stamping, stood up in relief. If, however, the gem were itself to carry the design in relief, the cutting was what we call *in rilievo* or *cameo* (Latin *gemmæ cœlatæ*, Greek *ektupa*). Cameo was the favourite mode of treatment for those stones which are composed of variously coloured layers, as the onyx, the sardonyx, &c., the layers being made use of to shade the picture or to yield a natural background of a different colour to the design; as when, the design being cut in an upper layer, the remainder of that layer was cut away, so that the underlying layer was exposed and formed a background of contrasting tint. Modern cameo cutting is more usually in softer materials, as the well-known shell-cameos cut in the large "Bull's Mouth" or the "Queen's Conch" shells, giving a design in pale buff on a reddish-brown or on a pink ground respectively. It seems likely that the word *cameo* is a corruption of *gemma*. The favourite gem-stones among the ancients were cornelian, sardonyx, chalcedony, agate, onyx, jasper, and heliotrope. Those next admired were rock-crystal, turquoise, amethyst, green quartz and serpentine. Very few of the stones jewellers now call gems were used for gems in the antique sense, in comparison with the stones named above, but some ruby, sapphire, emerald, green beryl, and aquamarine antique gems are found, and in rather greater abundance some of jacinth, topaz, chrysoprase and garnet. Imitated jewels (what are called "paste") were as common with the ancients, as we learn from Pliny, as with ourselves.

The Greek gems are wonderfully beautiful, the prime period being the reign of Alexander the Great; the well-known portrait of the king in a gem by Pyrgoteles is perhaps the chef-d'œuvre in this kind of art. It is certain that the wheel, the drill, the diamond-point, and probably

Engraved Babylonian Signet—Jasper.

the magnifying glass, the utensils of the artist in precious stones to this day, must have been thoroughly known to those who produced works of such consummate accuracy and finish. The skilful way in which any veins or spots of colour are turned to account in the design is most remarkable among Greek gems. In beauty and delicacy they as far excel their masters the Egyptians as the latter went beyond the Babylonians. Whether gem-cutting originated with the last-named people is of course not known; but Babylonian gems yet exist which are from 2500 to 3000 years old. A specimen of a Babylonian engraved signet cylinder is annexed. It seems likely that these signets were worn hanging from the waist. They are usually a little over an inch in height and about half an inch in diameter.

All the ancient nations used gems, not only as signets, however, but as ornaments for the dress, especially the girdle, sword-belt, &c., and for the handles of swords and weapons. Some beautiful cameo-gems are also found let into the surfaces of vases and goblets by the Greeks.

But while the Greeks in their love of beauty made precious stones a vehicle for art, the later Romans in their love of wealth found the gem effective as a way of displaying their vulgar ostentation; thus also do the purse-proud parvenus of to-day use their costly diamonds. The rage for cameo-gems under the early emperors was phenomenal. The distance from the plain iron signet-ring of the republicans, when only ambassadors might have a signet of gold, was vast indeed. We can hardly recognize the people as the same when, only a century later (or at most two), we find from Pliny that the middle finger was alone allowed to remain uncovered by crowded rings of great value. Rich people had their heavy winter rings, their lighter summer ones; enormous sums were devoted to these collections. Special ring cases (*dactylistheca*) contained the large assortments of gems necessary for each person of fashion. Pompey the Great gave a whole dactylistheca full of gem-rings taken from Mithridates as a votive offering to the Capitoline Jupiter; and Cæsar, not to be outdone in magnificence, gave six collections to the great temple of Venus Genitrix. This rage for gems debased the art, for of course an inferior and cheaper cutting was necessary to meet the wants of those whose purses could not provide Greek work. Roman gems are therefore exceedingly mixed in quality. Some of them rival the Greek gems, and were in fact the work of Greek artists resident at Rome; others are so rough as to be but little worth.

After a long period of stagnation, shared in common with all other arts, gem engraving arose again as a fine art in the latter half of the fifteenth century, under the Medici. Lorenzo the Magnificent, at Florence, was a generous patron of the workers in gems, and when the Medici family arrived at the papal throne in the person of Leo X., Rome itself favoured the difficult and costly art. This *cinquecento* work is most remarkable. So skilful did the artists become that about the middle of the sixteenth century the diamond itself was engraved; and the honour of the first accomplishment of this difficult feat is contested by at least two engravers. There has been little if any of the finest work produced since the sixteenth century. Though practically imperishable, and though marvellously beautiful, the labour involved in the slow cutting of gems is so excessive and so trying in its minuteness that it is scarcely probable that this form of art will be again revived. An age which condemns the labour of the steel-engraver as over-wasteful is not likely to look with favour on the infinitely slower and more painful toil of the worker in gem-engraving.

The symbolical uses and meanings of gems, wherein each stone had its peculiar medical or psychological virtue, or typified its peculiar god (or in later times its peculiar saint), so that it might be worn as a charm; and the superstitions or poetical fancies attaching to many stones, especially to the opal, present so wide and uncontrolled a field that it would be beyond the limits of this work to enter it. Such a symbolism, though the key is now lost, probably lay at the root of the selection of stones in the breastplate of the high priest of Israel, and guided the description of the precious materials composing the structure of the New Jerusalem, as told in the Apocalypse. It must be remarked, in conclusion, that the ancients were careless in nomenclature, and that different stones were often called by the same names (as sapphire and lapis-lazuli); and also stones went by different names at different periods. It needs, therefore, great caution to translate ancient accounts of jewels. Usually, for example, the chrysolite of the Authorized Version of the Bible is our topaz, while the topaz of the Bible is our peridote; the jacinth (or hyacinth) of the Apocalypse may be our sapphire, but this is not quite proved.

GEMS-BOK (*Oryx gazella*) is a species of antelope met with in South Africa; it is the *Antilope oryx* of some authors. Both names indicate its strong resemblance to the oryx of the ancients. Its horns are 3 feet in length, straight and slender, ringed at the base and tapering to a point. Its ears are large and pointed. The hair of its neck is reversed in direction. The head is white, and crossed by black transverse bands. The prevailing colour of the skin is rusty gray above and white below. The legs are white, with black-coloured thighs. The bushy black tail is 3 feet long, and sweeps the ground. The gems-boks inhabit open plains, and dwell together in pairs in small herds of four or five. It is a strong, bulky, and courageous antelope. It stands over 3 feet high at the shoulder.

GENDAR'MERIE (Fr., from *gens d'armes*, men-at-arms) was a chosen corps of cavalry under the old monarchy of France. The gendarmerie were afterwards formed into a body of soldiers intrusted with police duties all over France; it furnishes patrols, arrests criminals, examines the passports of travellers, and contributes to the maintenance of good order. They are divided into foot and horse. They form a distinct corps in the army, under their own superior officers, who are under the orders of the ministers of the interior and of police, but in case of war they may be called into active service like the other corps of the army. The gendarmerie is mostly recruited from old and deserving soldiers of other regiments, who consider it as a promotion, as they have better pay and enjoy greater liberty. This explains why the gendarmes, generally speaking, are remarkably well-behaved and trusty men. The force at present consists of about 25,000 men. A similar description of troops exists in Italy, where they are called Carabineers.

GEN'DER is a grammatical principle entering into the structure of nearly every language, according to which nouns are distributed into classes. There are, strictly speaking, only two genders, *masculine* and *feminine*; those which belong to neither of those classes were said to be *neutrius generis*, of neither gender; this third class are called somewhat incorrectly *neuters*, and hence by a second irregularity it is the ordinary practice of grammarians to speak of three genders.

The Latin with its three genders yet developed into Italian, French, and Spanish with only two. This occurred in several ways. Neuter substantives became masculine, and even as early as Plautus we find a new word *dorsus* (masc.) for the original *dorsum*, back (neut.); a little later than his time the evil was so crying that it produced loud lamentations from the grammarians; as for example when Fortunatianus (450) holds up hands in horror at "hunc theatrum et hunc prodigium," for "*hoc*," &c., the vulgarisms of his day. Further, the neuter substantive plurals in *a*, such as *vestimenta*, clothes, &c., were taken as feminine singulars in *a*; so in our own day we talk of *agendas*, as if *an agenda* were not a solecism. There is a curious alteration of gender in the French feminines in *eur*, as *douleur*, *chaleur*, &c., which come from the Latin masculines *honor*, *-orem*; *dolor*, *-orem*, &c. The classicists of the "Pleiade" school (Ronsard, Du Bellay, &c.) wrote in vain *le douleur*, *le chaleur*, &c.; they succeeded in rescuing only two words of the whole numerous series, *honneur* and *labeur*. On the other hand, Louis XIV. having, by a slip of the tongue, spoken of *mon carrosse*, the grovelling flattery of the court made *carrosse* masculine, and so it remains to this day.

German retains the three genders of ancient Teutonic speech. English, however, has practically abolished gender, except as to the mere difference of sex. Sometimes, as in the expressions, "the ship sails her best," "the sun shines his fiercest," objects are personified, and so take on an apparent gender; but this is not to the point.

In a few English words the gender-form still remains. The first of these is the feminine *en* of Old English; as *fox* (male), *vixen* (female). So we find in Thomas Cromwell's correspondence about the dissolution of the monasteries, "Many of the *mynchyns* be also agyd" (aged), where *mynchyn* stands for "nun," *mynch* or *munech* being "monk." The second is the feminine ending *estre*, as *spinner* (male), *spinestre*, *spinster* (female). Most of these, as *baxter* (female baker), *webster* (female weaver or webber), exist now only in surnames; some, as *songster*, *huckster*, &c., are used for men also. The French feminine in *ess* has superseded for sex-purposes the English *en* or *estre*; instead of *gyden* we say "goddess," &c. We even add *ess* to *estre*, as in *sempstress*, *songstress*, &c. Where we cannot do this we use compounds, "tom-cat" and "tabby-cat," "cock-sparrow" and "hen-sparrow," "he-goat" and "she-goat," &c.

English is rich in a curious collection of unrelated words expressing gender. Such are *father* (supporter) and *mother* (producer); *brother* and *sister*; *son* (one who is born) and *daughter* (a milker); *uncle* and *aunt*; *king* and *queen*; *husband* (house-master) and *wife* (woman), &c. So also with animals, *boar* and *sow*, *buck* and *doe*, *ram* and *ewe*, *hound* and *bitch*, *stallion* and *mare*, *cock* and *hen*, &c.

GENEAL'OGY is that branch of antiquarian studies devoted to the tracing out of family history. The yearly publications of Burke, Debrett, Lodge, &c., and their large sale, to say nothing of the European circulation of the *Almanach de Gotha*, show that this science in the minds of many people of the present day is by no means so devoid of interest as it might at first sight appear. Occasionally, as in the descent of titles in the peerage, or in tracing out and comparing the nearness of kin in the inheritance of an estate, or in balancing the claims of competitors for a throne, genealogists rise suddenly into importance of the highest degree. The terrible Hundred Years' War of England with France, and the still more terrible Wars of the Roses in England itself, were simply disputes on genealogical points—so far, that is, as they may be attributed to any nominal cause. Probably the true causes lay deeper, but these were the avowed subjects of quarrel.

Genealogy rests upon the pronounced degrees of CONSANGUINITY, and its main function is the accurate drawing up of genealogical tables, and the interpretation of them according to the scheme of consanguinity adopted. Occasionally a custom like BOROUGH ENGLISH or the SALIC LAW has to be reckoned with in declaring the heir at any given time, but usually the custom of PRIMOGENITURE is followed. The eldest son of the eldest branch will therefore (saving for local exceptions, such as those named) be the next heir.

In practical matters, as has been said above, genealogical accuracy will be often of service; but the curious fancy of some persons, otherwise quite unremarkable, to trace their remotest pedigree if it contains a famous ancestor—as if to show how the finest races may degenerate—is certainly almost inexplicable. For if the descendant of Alfred the Great is himself ignoble, what avails his descent save to point a dishonourable contrast? Even if the descendant be worthy, and on the score of his descent assumes to be superior to men otherwise his equals or more than his equals, the pride of the "old birth" against the "new men" is extremely curious. For clearly in our example Alfred was the greatest man of the family, else why the efforts to trace, however obscurely, a descent from him? This was the answer of Caius Marius, and this the answer of Napoleon to taunts as to their modest ancestry; namely, that they were themselves the ancestors of their family—they the "new men" were founding a race, just as the famous ancestors of the "old birth" had, in their far-off time, done.

The lines of the witty poet Prior irresistibly occur to the mind:—

> "Ladies and gentles, by your leave,
> Here lie the bones of Matthew Prior,
> The son of Adam and of Eve;
> Can Nassau or Bourbon go higher?"

Examples of genealogical tables will be found in the article ENGLAND, which, though very much compressed (for all the individuals or branches not required for the purpose of that article are necessarily omitted) will yet be quite sufficient to indicate the mode of drawing up such tables. If John Smith marries Ellen Jones and they have two children, James and Mary; and if James marries Susan Brown and has two children, John and Henry, this would be indicated as under, dates being omitted for the sake of clearness:—

```
        John Smith = Ellen Jones.
                   |
        ___________|___________
        |                     |
James = Susan Brown.        Mary.
        |
     ___|___
     |     |
   John. Henry.
```

The mode of continuing this "family tree" is obvious.

GENERAL, a title conferred on military men above the rank of field-officers. In all the states of Europe it indicates the commander-in-chief of the forces of the nation, the commander of an army or grand division, and also those who, under the latter, exercise his functions, with the designations of lieutenant-general and major-general.

The origin of the title appears in the history of France, in which country it seems to have been conferred on the commander of the royal army about the middle of the fifteenth century, when something like a regular military force was first established in Europe. The kings were then considered as holding the chief command of the army in virtue of their birth, and on appointing persons under them to exercise a general superintendence of the forces, they gave to such officers the title of *lieutenant-general*. It must be remarked, however, that, at a period antecedent to that of the creation of lieutenant-generals under the sovereign, the title of captain-general had been conferred on certain officers with military jurisdiction over particular districts; and the nature of the duty therefore seems to have resembled that of the inspecting field-officers now appointed to particular divisions of this country and the colonies.

The English nation has nearly followed the practice of France in matters appertaining to the military service, and the title of captain-general occurs in the list of the army which served at St. Quentin in 1557, of which list a copy is given by Grose from a MS. in the British Museum. From the list it appears that a lieutenant-general for the whole army was immediately subordinate to the former; and that under the last was a general of horse, a captain-general of foot, with his lieutenant, and a sergeant-major (corresponding to a present major-general). In the army which, in 1620, it was proposed to raise for the recovery of the Palatinate, and in that raised by Charles I. in 1639, the commander is entitled to lord-general; a lieutenant-general appears as the second in command, and the third is designated as the sergeant-major-general. It was probably soon after this time that the last officer was called simply major-general; for we find that in 1656 Cromwell appointed twelve officers under that title to have civil and military jurisdiction over the counties of England (Clarendon, b. 15).

In France, during the reign of Louis XIV., and perhaps at an earlier time, the naval commander immediately below the rank of vice-admiral was entitled lieutenant-general. A similar designation seems to have been early employed in the English service, for in the time of Queen Elizabeth the commander of a squadron was called the general; and as late as the time of the Commonwealth a joint commission of admiral and general was given to Blake and Montague, though the expedition on which the fleet was sent was confined to an object purely naval.

Although a major is higher in rank than a lieutenant, a major-general is beneath a lieutenant-general, a curious anomaly, which sometimes produces confusion in the minds of non-military readers. In the British service there are about 60 full generals, 100 lieutenant-generals, and 160 major-generals; but of this number many command particular regiments as colonels, or hold military governments in the country and colonies; some of them have only local rank; and some have retired from the service, retaining the title, but without receiving pay or being qualified for obtaining any progressive promotion.

In the English army, a general of division is either a major or lieutenant-general placed in command of a division of an army in the field, and a brigadier-general is either a colonel or major-general in command of a brigade —the titles only lasting while the officer is actually holding the command. In the French service, however, *general de brigade* and *general de division* are permanent ranks, answering to our major-general and lieutenant-general. The pay in the English army is as follows:—General officers hold 164 honorary colonelcies of regiments, worth on an average £1000 each per annum. Those not possessing a colonelcy receive unattached pay of £600 per annum, if they have been in the guards; £1 6*s*. a day, if in the artillery or engineers; and £1 5*s*. a day, if previously in the line. When employed on active service a general receives in addition £5 13*s*. 9*d*. a day; a lieutenant-general £3 15*s*. 10*d*.; and a major-general £1 17*s*. 11*d*., besides various allowances. According to the estimates for 1884–85 there were eight lieutenant-generals, twenty-one major-generals, and seven brigadier-generals actively employed, exclusive of those serving in India.

The military *staff* of Great Britain at headquarters consists of the commander-in-chief, the adjutant-general, and the quartermaster-general. The duty of the adjutant-general falls partly under that of the sergeant-major-general in the sixteenth century; in the field he receives the orders from the general officer of the day, and communicates them to the generals of brigades, and he makes a daily report of the situations of all the posts placed for the security of the army.

The quartermaster-general corresponds in part to the harbinger of the army in the sixteenth century. This officer has the charge of reconnoitring the country previous to any change being made in the position of the army; he reports concerning the ground which may be favourable for the site of a new encampment, and upon the practicability of the roads in the direction of the intended lines of route. He also superintends the formation of the encampment and the disposition of the troops in their cantonments.

GENERAL ASSEMBLY OF THE CHURCH OF SCOTLAND. This is the Scottish ecclesiastical parliament, and the highest court of the Presbyterian Church. Its functions are to legislate for the church, and to act judicially against any of the members of the church for alleged impropriety of conduct or doctrine. The Assembly consists of representatives, clerical and lay, from all the presbyteries of the church, of which there are eighty-four, composing sixteen synods. The royal burghs of Scotland also return elders, and each of the Scottish universities send a representative. The General Assembly meets annually in May at Edinburgh, and sits for ten days. The president is called a Moderator. Each parish has its kirk-session for the management of the parochial business. From this an appeal lies to the presbytery; from the presbytery to a synod, composed of two or more presbyteries; and lastly, from the synods to the General Assembly, whose

decision is final. A Lord High Commissioner represents the sovereign in the General Assembly, but his presence merely implies the sanction of the civil authority. He has no voice there. The Assembly only recognizes the sovereign as the head of the state with which the church is allied, not as the head of the church. The Free Church of Scotland also has a General Assembly of its own, comprising seventy-one presbyteries, but it is not recognized by the government more than the assemblies of other sects.

GENERAL BASS is the old German term for what in England was formerly called *thorough bass*, namely, the study of HARMONY, so far as reading or working out a FIGURED BASS.

GENERAL SHIP, a vessel that is advertised to receive goods in parcels of any size, for some specified place or places, and to sail when full, or, as is usual in the case of a steamer, at a particular time. Commercially this is called laying a ship on the berth. Parole evidence in such cases is admitted of agreements to ship and receive any parcel, and the only documents that are usually in existence are the advertisement and the bills of lading, which are often signed by the ship's agents, acting on the mate's receipts left by the captain after her departure.

Agreements made with the captain, unless it is otherwise specified, overrule those made with the owners apart from the captain; but if notice be immediately given at the ship's side, preference is given to such goods over chance parcels. Notice must be given to the owners of any parcel on board of any changes in the advertised arrangements. A cargo composed of parcels shipped in this way is called a general cargo.

GENERALIZA'TION. See GENUS.

GEN'ERATING FUNCTIONS. The term *generating function* is a name given by Laplace to any function of x, considered with reference to the coefficients of its expansion in powers of x, as follows: if

$$\phi x = \psi 0 + \psi 1 \,.\, x + \psi 2 \,.\, x^2 + \ldots + \psi n \,.\, x^n + \ldots$$

then ϕx is the generating function of ψn. Thus the generating function of n is $x \div (1-x)^2$, since the coefficient of x^n in the expansion of the preceding is n.

GENERA'TION is used in mathematics to represent the formation of a solid figure by the movement of a plane figure, or the formation of a plane figure by the movement of a line, &c. Thus the revolution of a line around one end of it as a centre generates a circle; the revolution of a triangle around one of its sides as an axis generates a cone, which will be a right cone or an oblique cone according as the axis is perpendicular or inclined to the base. In like manner in algebra and arithmetic numbers or quantities are generated by the inter-action of other numbers or quantities; but the term is not often used except as to multiplication, especially by powers (as when 16 is generated by 2 involved to the fourth power), or as to GENERATING FUNCTIONS.

GENERA'TION, SPONTA'NEOUS. Can living substance ever be evolved out of non-living substance? It is an old—a very old—question, to which the philosophers of successive centuries have given different answers, and which in recent years has been the subject of very considerable scientific inquiry and controversy. We propose to consider what the result of the evidence up to the present time is on this question, which has engaged the attention of mankind from the earliest dawn of science.

The most prominent champions who have of late years entered the lists in this great quarrel are Professor Tyndall, who maintains that all living things, without exception, are the products of previously living matter, and Dr. Bastian, who maintains that his own experiments and those of others who have preceded him in the same field establish the possibility that living organisms may be evolved out of non-living materials.

In the early dawn of scientific thought, when authority counted for more than experiment, and *à priori* fancies took the place which belongs of right to inductive investigations, a kind of philosophical faith was the only representative of scientific opinion. With or without reason, however, the world had satisfied itself that the true faith was that hordes of living creatures were daily and hourly evolved out of non-living matter. Whenever life appeared the origin of which was not palpable to the eye, it was assumed to be a case of abiogenesis, *i.e.* life without living parentage. The maggot developed in putrid meat was allowed no parent except the carcase on which it fed, and other blunders, equally gross, were made (as was natural) by inquirers who did everything except inquire.

About two centuries ago, when the spirit of induction had laid a firm hold on the minds of men, even biological science felt the revolution. Redi, a Florentine physician, seems to have been the first to test the accepted doctrine of spontaneous generation. By the simplest process in the world he proved that putrid meat did not generate maggots. He kept the blowflies away, and the maggots did not appear. He collected the blowflies' eggs, and hatched his maggots without the presence of the flesh which had so long been their reputed parent. Similar results followed in other like cases, and having shown that gentles and other creatures, whose origin he investigated, certainly were not the products of spontaneous generation, Redi conceived the theory that spontaneous generation was a fiction from beginning to end, and that the exclusive method of nature was expressed by what has since become the familiar maxim, *Omne vivum ex vivo*—"every living thing is derived from a living principle." Until the commencement of what may be called the microscopic age there were no means of carrying the investigation further. By this time, however, the maxim *Omne vivum ex vivo* had got associated with ideas, now almost exploded, about distinctive vital forces, and had become as firm an article of faith as the opposite doctrine had been before Redi discredited it. A new era was commenced, and it is to the revelations of the microscope during the last century, and especially in quite recent times, that both parties to the controversy appeal. The programme of all these experiments has been the same. First destroy and exclude every trace of life—then see if under any influences life can be evolved. At each successive stage the stringency of the methods employed has steadily increased. In all of them, however, heat has been the destructive agent employed. Needham took a solution of hay, boiled it to destroy all life within, and corked and sealed his flasks to exclude all access of life from without. Nevertheless his solutions bred animalcules, and he ascribed the fact to spontaneous generation. Spallanzani repeated the experiment with severer precautions. He boiled his solutions longer, and hermetically sealed his flasks instead of corking them. No animalcules appeared, and so far the inference seemed irresistible, that the source of life in Needham's experiments was something which might be destroyed by heat and excluded by a film of glass. If so, what more likely than a germ? Schwann followed on the same side. He calcined air and allowed it to approach his boiled solutions, and no life appeared. He admitted ordinary air, and life abounded.

Pasteur, himself a strong opponent of spontaneous generation, repeated Schwann's experiments, and though he too at first obtained only negative results, he found that when the solution contained certain alkaline fluids life appeared in spite of the boiling and the calcining. This showed that to generalize from Schwann's results would have been at least premature; but further experiments satisfied Pasteur that if the heat applied was raised from 100° to 110° C., the power of evolving life disappeared even from alkaline solutions. Pasteur therefore concluded

that in every instance in which life had appeared in an organic solution, it sprang from germs which had either been allowed to remain alive in the fluid under experiment or else had fallen into it from the surrounding air. Professor Wyman, however, of Cambridge, U.S., Professor Mantegazza, of Turin, and Professor Cantoni, of Pavia, all tried experiments in which temperatures of from 120° to 142° C. were employed, and notwithstanding this they found living organisms in their solutions. And Dr. Bastian, in his "Spontaneous Generation," published in 1870, minutely described and pictured the living organisms which he obtained from hermetically-sealed flasks, some of which had been subjected by Professor Frankland to a temperature of 150° C. for several hours. See PROTOPLASM.

Pursuing his investigations still further, Dr. Bastian published in 1871 his "Origin of Lowest Organisms," and in 1872 "The Beginnings of Life." These works, which opened a new world to biologists and microscopic students, contained revelations more remarkable and startling than any that had appeared since the publication of Mr. Darwin's "Origin of Species." Dr. Bastian's experiments appeared for the time conclusive of the fact that whenever animal or vegetable life arrived at a certain stage of decomposition, spontaneous generation took place, *i.e.* organic life started into existence as an accompaniment of that decay, and altogether irrespective of any germs or spores floating in the atmosphere. Active nematoid worms were observed to develop from a shrivelled dying portion of the plant Vaucheria.

In another group of experiments Dr. Bastian dealt with infusions or decoctions of hay, turnip, cheese, or flesh. These were submitted to an amount of heat which had been found sufficient to destroy life in solutions, and afterwards repeatedly passed through filtering paper. Very few of the infusions failed to evolve bacteria, which under the microscope were seen to develop and dart about with their characteristic motions.

The argument of Dr. Bastian appears to be that, instead of the origination or creation of life at a period previous to the deposition of the Silurian rocks, in the form of a germ cell which was in process of time the progenitor of articulate, molluscan, cœlenterate, and vertebrate life, the ancestors of our existing forms are being produced every day by spontaneous generation, or the conversion of inorganic into organic matter. He applies this argument to man by saying, "How long or when the particular tree of life, from one of the branches of which man was developed, appeared upon the earth, it is utterly impossible to say. The vertebrate grade of organization may have been many times attained by ultimate branches of different boughs of the tree of life."

In his work on "Evolution and the Origin of Life" (London, 1875), Dr. Bastian pursued the same subject, but without advancing any more convincing arguments or facts. Responding to the challenge, Dr. Tyndall in 1876 undertook, in a series of lectures and experiments before the Royal Society, to show that spontaneous generation was an absolute impossibility, and that if solutions open to the air soon swarm with life, it was because they had been impregnated with living particles floating in the air. Various methods were adopted of purifying or freeing the air from floating motes—fire, the action of acids, filtering through cotton wool, &c. It was found, moreover, that if air be allowed to remain in a closed air-tight glass case, covered inside with glycerine, in the course of three or four days it deposits all its motes, which adhere to the glycerine, and it thus becomes quite free from them. The test of its perfect freedom is to pass a powerful beam of light through the case. If still floating they make known their presence by reflecting the light, whereas a glass chamber filled with purified air remains dark, even in the track of a highly concentrated beam of light. There is nothing to reflect or scatter the light, and Professor Tyndall laid down the axiom that air which has lost its power of scattering light has also lost its power of producing life.

The infusions and solutions having been prepared in the proper manner as laid down by those who believe in spontaneous generation, a number of infusions were submitted to the influence of ordinary air, and other samples to the air divested of its motes—purified. In every instance, however often repeated, the infusions protected from motes showed no change, while the exposed samples soon became putrid, and showed signs of low forms of life. "Now," argued Professor Tyndall, "though we know nothing about motes of the air, suppose these motes were so large that we could handle them. If we took two pots of earth, planted the motes in one, and carefully kept them from the other, and if we got a crop of cresses and grass from the first, and nothing from the second, we should surely argue that the motes contained the germs of this vegetation. So with these motes and the infusions which favour their development. We allow them to settle in one set of infusions, and get a crowd of life forms; we carefully keep them away from another set of infusions, and get no life. Surely the minute motes contain the germs among them."

Dr. Bastian, on the other hand, pointed out in reply, that except in Professor Tyndall's manner of freeing the air from its particles, there was nothing new in these results; and that boiled organic solutions exposed to purified air, or in flasks from which all air and whatever it may contain had been expelled, had been found to putrefy and swarm with life by Schwann, Pasteur, Fouchet, Jeffries, Wyman, Cantoni, Huitzinga, Roberts, Sanderson, and others. Several of the authorities quoted by Dr. Bastian—notably Pasteur—were, however, led by the balance of evidence to pronounce the theory of spontaneous generation to be a mere chimera.

Writing again on the subject early in 1877, Professor Tyndall said he thought that among the multitude of germs contained in a given fluid, some, being those nearer maturity, are soft, and are destroyed by a comparatively low temperature; while others in various earlier stages of growth are more or less indurated, and resist stronger measures. He therefore, in place of one continuous boiling, subjected the fluid to several successive heatings, at intervals of ten or twelve hours, thus catching each successive crop of germs as it arrived at the stage of non-resistance, and finally extinguishing the whole. Each of these exposures to heat required, he said, only an extremely brief period of endurance. Dr. Bastian naturally took advantage of Professor Tyndall's change of view as to the difficulty of destroying living germs by the process of boiling, and pointed out that whereas the professor maintained in 1876 that all living germs could be sterilized by five minutes' boiling, he now held that there are living germs which would resist three or four hours' boiling, and yet evolve active forms of life after all. Dr. Bastian himself of course interpreted this result differently. He did not think there was any living germ which would resist anything like three or four hours' boiling; and his view was that when life appears in infusions which have been boiled for a considerable time, it is not because the living germs survived the boiling, but because life is produced, under fitting conditions, from that which had no germ of life in it before.

In the summer of 1877 Professor Tyndall confirmed the results of his previous investigations by some further experiments in the Alps; and in communicating the results to the Royal Society in the following December, he said he considered that the question which had for years interested men of science might now be regarded as finally answered, and that it had been conclusively shown that there was no such thing as the spontaneous generation of bacteria, &c.

The method to be employed in boiling to destroy germs in the infusions used had been thought out and experimentally tested. It was the difficulty of killing germs in the infusions, and of being sure that the infusions were opened in air free of germs, that led to all the early mistakes and caused the belief in spontaneous generation. Professor Burdon-Sanderson, who some time before favoured a belief in spontaneous generation, afterwards announced himself as quite in accord with Professor Tyndall on the general subject.

GEN'ESIS, the name given in the Septuagint to the first book of the Pentateuch. In the Hebrew it is called *Bereshith* (in the beginning), from the initial word. In the Authorised Version it is divided into fifty chapters, but such a division is merely one of convenience, and the book may be fairly divided into two distinct portions, the first devoted to the account of the creation and the general history of the world until the call of Abraham, and the second dealing with the history of the patriarchs up to the settlement in Egypt.

It is generally admitted that the book is characterized by a distinct plan and method, and that it forms an integral part of a larger whole, which includes the three following books. The relation between God and Israel forms the key to the book, and the earlier portions seem designed to lead up to this. Thus while its story embraces the whole world and speaks of God as the God of the human race, by the introduction of Jewish history it makes the universal interest subordinate to the national; and as the different families separate from the central stock a brief indication of their course is all that is given. The period of time over which the Book of Genesis extends has been variously estimated, and the chronology of the book presents numerous difficulties. According to the Hebrew text adopted in the Authorized Version, the deluge took place in 1656 A.M.; according to the Septuagint in 2262 A.M.; the former giving 4004 B.C. and the latter 5411 B.C. as the epoch of the creation of man. From the deluge to the common date of the birth of Abraham the Hebrew text gives 292 years, the Septuagint 1072. Josephus makes the period from the creation to the deluge 2256, or six years less than the Septuagint. By the Jews the Book of Genesis was ascribed to Moses, and this belief was generally accepted in the Christian Church up to a comparatively recent period. This view was contested by Spinoza in 1679, but it was not until the middle of the eighteenth century that careful and discerning criticism was applied to the composition of the books of the Pentateuch. The first important work on the subject was that published by M. Astruc, court physician to Louis XIV., at Brussels, in 1753, entitled "Conjectures sur les Mémoires originaux du Livre de la Genèse." In this work M. Astruc propounded the theory that the peculiar use of the divine names in the Book of Genesis and the first six chapters of the Book of Exodus showed that two original documents had been used by its compiler, one of which was marked by the use of the term *Elohim*, and the other chiefly by that of *Jehovah*. Besides these two writings he supposed he could trace ten different memoirs which had also been made use of in the composition of the book. This theory attracted but little attention at the time, but it was at a later period adopted in a modified form by Eichhorn; and with many further modifications it has been adopted by perhaps the largest number of biblical critics up to the present day. These consider that the book does contain portions of two original documents, characterized not only by the use of the divine names already referred to, but also by marked differences of style and expression, and that in some places we have the same story as told by the two writers, and in others their narratives interwoven. There are also traces of other independent sources of information which have been utilized or copied literally by the compiler of the book. While these results of criticism, however, are pretty generally accepted there yet remains a wide divergence of opinion as to the authorship and date of the book. By the critics of the conservative school it is contended that the two documents referred to are as old as, and probably older than, the time of Moses, and that they were adopted and utilized by him in the composition of the work; while on the other hand the book is ascribed to three authors, at least by Hupfeld, while Ewald considers it has four, and that seven distinct writers are to be traced in the whole Pentateuch. The date has also been by different scholars assigned to the period of Saul, that of Elisha, of Uzziah, and of Manasseh with a final editing by Ezra. The great differences that exist between the various scholars who have attempted the solution of the problems presented by the book show upon what uncertain ground these criticisms are based, and the insufficiency of the theories propounded by them have been pointed out by a series of able and learned critics, including Hengstenberg, Hävernick, Ranke, and Keil. It is not disputed that the book *in its present form* was not written by Moses, such passages as Gen. xii. 6; xiii. 7; xiv. 14; xxiii. 2; xxxvi. 31; xl. 15, being evidently of much later origin.

The interpretation of the opening portions of the book, so far as they contain the account of the origin and fall of man, has exercised the ingenuity of commentators from a very early period. By Philo, and the philosophers of the Alexandrian school, the narrative was interpreted allegorically, and in this they were followed by Papias, Irenæus, Justin Martyr, Augustine, and others of the fathers. At a later period, and after the Reformation, the literal interpretation, by which the story is taken as veritable history, came into favour and largely influenced Christian theology. One of the fundamental positions of the Calvinistic system, for instance, is that Adam was the covenant head or federal representative of the human race, which became involved in the consequences of his transgression. The literal theory is at the present day advanced by many Christian expositors, but there are a large number of scholars who see in the story only the Jewish version of a legend of Semitic origin and common to other nations.

The cosmogony of the opening chapters of the book has also excited violent controversy, and numerous attempts have been made to reconcile the account given in Genesis with the teachings of geological and astronomical science. That the origin of the world and of the human race must be placed at periods immeasurably more remote than even the longest of the chronologies based upon the record of Genesis is now all but universally admitted, but many theories have been advanced by Christian apologists to meet this difficulty. According to one of these the geological ages are to be considered as having come to an end before the first day, but the theory that obtains most general acceptance is that which interprets the six days as six periods of vast and undefined duration. Numerous attempts have been made to identify these periods with corresponding geological epochs, but the constant repetition of such efforts is sufficient to show that no satisfactory reconciliation has been effected. Perhaps the most rational view to take of this controversy is that which has been expressed by an eminent biblical critic and scholar of the conservative school, viz., "No reconciliation is necessary. It is certain that the author of the first chapter of Genesis, whether Moses or some one else, knew nothing of geology or astronomy. It is certain that he made use of phraseology concerning physical facts in accordance with the limited range of information which he possessed. It is also certain that the Bible was never intended to reveal to us knowledge of which our own faculties, rightly used, could put us in possession; and we have no business therefore to expect anything but popular language in the description of physical phenomena."

One thing is certain that when the account in Genesis

is compared with such cosmogonies as are found in the sacred writings of other nations, it will be found immeasurably their superior both in the grandeur of the conceptions expressed and in its teaching concerning God as the Creator. There is no trace either of dualism or pantheism, and the pre-existence and independence of the almighty Author of the universe is clearly expressed. The second portion of the Book of Genesis is written in a style singularly easy, simple, and natural, and the narrative abounds in touches of great pathos and beauty. The biographical sketches it contains bear on their front the stamp of truth, and give a vivid and interesting picture of patriarchal life, while the closing chapters display a full and accurate knowledge of Egyptian manners and customs.

GEN'ET (Genetta) is a genus of carnivorous mammals belonging to the family VIVERRIDÆ. The nearest allies of this genus are the civets. In the genets the odoriferous anal pouches are reduced to a slight depression formed by the projection of the glands, and have no perceptible excretion, although the odour is manifest. The pupil has a vertical slit, and the claws are entirely retractile, as in the cats. The genets are smaller than the civets, and less frugivorous in their habits. The Common Genet (*Genetta vulgaris*) inhabits the south of France and other parts of Southern Europe, and Africa north of the Sahara. The fur is gray, spotted with small black or brown patches, which are sometimes round and sometimes oblong; the tail, which is as long as the body, is ringed with black and white, the black rings being to the number of nine or eleven. There are white spots on the eyebrow, the cheek, and on each side of the end of the nose.

The genet loves low lands, particularly the banks of the rivers and the neighbourhood of springs. In Constantinople it is domesticated and kept in the houses, where it catches mice as easily as a cat.

GENE'VA (*Genève*), the smallest of the Swiss cantons, except Zug, lies along the shores of the S.W. end of the Lake of Geneva, and extends a few miles W. along each bank of the Rhône. It is bounded N. by the canton of Vaud, E. and S. by Savoy, and W. by the French department of Ain. The area of the canton is 109 square miles; the population at the census of 1880 was 101,595.

The territory of Geneva is confined on the west by the lower offsets of the Jura, and on the east and south-east by the Mountains of Voirons and Sallève, which are about 4000 feet above the sea. These mountains, however, are out of the territory of Geneva, which contains only some hills, the highest of which are not 400 feet above the level of the lake. The territory of the canton is divided into three districts:—1. The district north of the Rhône, including a strip of land along the west bank of the lake as far as the borders of the canton of Vaud, beyond Versoix. 2. The district between the Rhône and the Arve, which includes Carouge. 3. The district between the Arve and the east bank of the lake, along which it extends in a narrow strip as far as Hermance. Numerous villages are scattered about the whole territory; and in the immediate neighbourhood of Geneva, both along the banks of the lake and in the direction of the principal avenues leading to the town, are extensive lines and groups of country-houses, which form handsome suburbs.

The territory of Geneva, though not naturally fertile, is rendered productive by the industry of the inhabitants; and recently the Swiss farmers have effected considerable improvements by draining and introducing the best agricultural implements. Less corn is grown than formerly, a great deal of land in many parts of the country having been turned into vineyards, as being a more profitable investment. Watches and jewelry are now the principal manufactures; and are exported chiefly to France, Italy, the Levant, and other countries. Numerous firms are now established in this canton for supplying cheap watches and jewelry for exportation, making use of the good reputation of the Genevese workmanship, whereas their watches contain inferior Neuchâtel works, and the cases only are manufactured here.

The republic of Geneva originated in the municipal government of the town, to which Charlemagne granted certain privileges and franchises, subordinate, however, to the bishop, who was styled Prince of Geneva. The line of the counts of Geneva, who also claimed and exercised jurisdiction over the town, became extinct in the fourteenth century, and their inheritance escheated to the house of Savoy, who, after several fruitless attempts to reduce Geneva, acknowledged its independence in 1603. A revolution took place here in 1847, and a new constitution was established, which guarantees civil and religious liberty. All forms of worship are allowed by the law, but the majority of the inhabitants belong to the Reformed Calvinistic Church. All male citizens of twenty-one years of age have a vote in the election of representatives to the council of the canton. There is one member for every 666 inhabitants. The representative must be over twenty-five years of age. A council of state forms the executive, and is composed of seven members, who are elected for ten years. The Geneva, Lausanne, Fribourg, and Berne Railway traverses the Canton. It has also railway connection with Paris and Lyons.

GENEVA, the capital of the above canton, is built on two hills divided by the Rhône where it issues out of the Lake of Geneva. The river forms an island within the town, which is built upon. The district on the north bank is called St. Gervais. A smaller island, at the point where the Rhône issues from the lake, is planted with trees and forms a public promenade, on which is a statue of Rousseau. A handsome suspension bridge is thrown across the river to connect both banks and the island; there is also a stone bridge. From the lake the city has an imposing appearance, but some of the streets of the old town are narrow and steep. The removal of the ancient ramparts, the providing of a harbour for steamers, and the erection of fine buildings and open streets in the newer portions of the town have, however, much increased the beauty and convenience of Geneva. The banks of the Rhône are flanked with broad quays. The most remarkable buildings are—the cathedral church of St. Pierre, the incongruous front and portico of which were added in the eighteenth century; an English church; the Hôtel de Ville, a very old and massive building, in which is the *Salle des Festins*, now known as the Alabama Chamber, in memory of the Anglo-American arbitration of 1872; the hospital; the Musée Rath, containing some good paintings; the college, which has a library of 100,000 volumes; the botanic garden; the observatory; the Hôtel des Bergues, and the penitentiary.

Geneva abounds with means of instruction. The Academy, founded by Calvin, has forty professors and four faculties—theology, law, sciences, and belles-lettres. There are drawing schools, industrial schools, in which mathematics, physics, and chemistry are taught; schools for music, gymnastics, &c. There are also societies of arts, of medicine, of physics and natural history; a reading-room, with the best European journals and a library of many thousand volumes; a museum of natural history; a cabinet of medals, and a botanical garden.

Geneva is now one of the most prosperous and improving towns on the Continent; and owing to its beautiful environs, and its position on the chief railways from France, it is a place of great resort with travellers, of whom in ordinary years about 50,000 pass through it. Steamers ply regularly to Lausanne and other towns on the shores of the lake. The chief manufactures are watches, musical boxes, and mechanical toys. The population at the census of 1880 was 68,320. The town is the seat of the central administration of the canton.

Geneva is one of the oldest towns in Europe. It is mentioned as an important place by Cæsar ("De Bel. Gal." i. 7). Many Roman antiquities have been discovered in and near it; and in the island traces may still be discovered of a Roman structure, supposed to be the foundations of one of the towers erected by Cæsar to prevent the Helvetians crossing the river. In 426 Geneva was taken by the Burgundians, and became their capital; it afterwards belonged successively to the Ostrogoths and the Franks, and formed a part of the kingdom of Arles and the second kingdom of Burgundy. On the fall of the latter it came under the sole dominion of its bishops, between whom and the counts of the Genevois, in Savoy, there existed incessant contests for its possession. In the midst of these dissensions the citizens of Geneva concluded an alliance with Fribourg and Berne. Two parties were thus formed in the town, the Confederates (German *Eidgenossen*, pronounced by the French *Iiguenos*, whence the term *Huguenots*) and the Mamalukes, partisans of the House of Savoy. At the Reformation the bishop was expelled, and the town, with its territory, became a republic. Calvin, having sought refuge in Geneva in 1536, was solicited to settle there, and was soon afterwards raised to the highest rank in the state, which he in a great measure governed for twenty three years, with a severity and strictness that impressed deep and abiding traces on its jurisprudence and manners. In 1553 the famous Michael Servetus, who had been arrested at Geneva at the instigation of Calvin, was accused of blasphemy in regard to the Trinity, and being tried and convicted, was ordered to be committed to the flames, which barbarous sentence was immediately carried into execution. The conduct of Calvin in this deplorable affair, though in part excused by the spirit and temper of the times, was directly hostile to every principle for which he had been contending against the Church of Rome, and will ever remain a dark blot upon his character and that of the early reformers. In 1782, in consequence of internal dissensions, Geneva was occupied by the troops of France, Sardinia, and Berne. It was taken by the French in 1798, and formed, till 1813, the capital of the department of Leman in the French Empire, under Napoleon I. In 1814, along with a small territory, it joined the Helvetic confederation. Since then numerous changes have taken place in the internal policy of the city. From 1847 to 1862 the extreme radical party had the upper hand, even the pauper class of the prolétaires having a vote, and an almost creedless church being supported by the state. Afterwards the more conservative party had the ascendency. This continued until 1878, though the conservatives were hard pressed by their opponents. The radicals again obtained power in 1880. Throughout these modern struggles, as in the past, the influence of religion over civil affairs formed one of the chief causes of dispute. The Duke of Brunswick, who had resided in the city many years, and who died there in 1873, bequeathed property to it valued at more than £1,000,000 sterling. No town, perhaps, of the same size can boast of such a list of illustrious names associated with it, either as natives, exiles, or voluntary residents—Farel, Calvin, Beza, Cranmer, John Knox, Lefort, Rousseau, Voltaire, Neckar, De Luc, Josephine, Marie-Louise, Sir Humphrey Davy, Sismondi, and Merle D'Aubigné.

GENE'VA (spirit). See GIN.

GENE'VA CONVENTION. See CONVENTION, GENEVA.

GENE'VA, LAKE OF, or **LAKE LEM'AN** (the ancient *Lemanus Lacus*, and the German *Genfersee*), extends in the form of a crescent from east to west between Switzerland and the French department of Haute Savoie. Its breadth varies greatly, being about 9 miles in the middle, 4 towards the eastern extremity, 3 in its western part opposite Nyon, and 1 mile just before reaching Geneva. This narrow part, which is about 14 miles in length from Nyon to Geneva, is called the Little Lake, and more specially the Lake of Geneva. The greatest length of the whole lake is about 50 miles. The depth below the cliffs of Meillerie, on the coast of Savoy, is nearly 1000 feet; it is 500 feet deep near the Castle of Chillon, on the opposite coast, and from 600 to 300 feet in other places. Its surface is about 1150 feet above the sea, but in summer it rises sometimes from 6 to 8 feet higher, owing to the melting of the snow in the Alps. The water reflects a bright azure tinge like that of the Mediterranean Sea. The Rhône, coming from the Valais, enters the lake at its south-east extremity, where the waters of the river are muddy-coloured; and it issues out of it again at Geneva at the south-west extremity, where its waters assume a deep blue tint. The area covered by the lake is about 331 square miles. Its waters are transparent, and contain a great variety of fish, though less than are found in other Swiss lakes. It is never wholly frozen over. It is subject to *seiches*, or risings of from 1 to 5 feet, which last about twenty-five minutes only, and are at present unexplained. A steamboat company established in 1873 has a regular service between several points on the shores of the lake, the scenery around which has been always a subject of admiration to travellers.

GENEVIÈVE, a saint of the Roman Catholic Church, considered the patron saint of Paris. She was born at Nanterre, near Paris, in the early part of the fifth century, and devoted herself, while yet a child, to the conventual life. She is said, by her prayers and fasting, and by those of her virgins, to have averted the threatened destruction of the city by Attila in 451. She died at a very advanced age, and was buried in what is now the Église St. Geneviève. Many wonderful legends are handed down respecting her. The third of January is the day of her festival.

GEN'GHIS KHAN, the son of a Mogul chief, was born in 1164. The horde which his father ruled over dwelt, so far as nomad tribes can be said to have a permanent abode, somewhat to the south of Lake Baikal. His original name was Temugin, which he exchanged for that of Genghis Khan, *i.e.* Khan of Khans, when he became the supreme ruler of the Moguls and Tartars. His father died when he was in his fourteenth year, and he was driven by the invasion of the neighbouring princes to the powerful khan of the Keraites for protection. That prince gave him his daughter in marriage, and raised him to high dignities. But Genghis Khan fell under his suspicion, and returned to his own kingdom for safety, where he defeated the troops sent in pursuit of him, and afterwards the khan himself (1202), and obtained his dominions. Gradually he united under his authority all the various hordes of Central Asia, and was proclaimed khan of the whole nation in 1206. He then announced his plan for the invasion of China and Southern Asia, organized armies on a vast scale, and in 1210 poured them upon China. At first peace was concluded, and Genghis Khan married the daughter of the King of China; but three years later Pekin and the northern provinces of China were annexed to the Mogul Empire. In 1218 Genghis Khan with an army of 700,000 men met Mohammed Kothbeddin, the most powerful of the monarchs of Southern Asia, near the river Jaxartes, and although the battle was indecisive, Mohammed was ultimately overthrown. Transoxiana, Khorasan, and Persia acknowledged the authority of Genghis Khan before five years more had elapsed; and in 1224 he returned to his capital, Karakoram, after having plundered and laid waste numerous cities, and destroyed, according to the calculation of Oriental historians, 5,000,000 human beings.

His empire now extended from the Volga to the Pacific, and from Siberia to the Persian Gulf; but he was again

seeking fresh successes in the southern provinces of China, when he died on the borders of that country on the 10th of Ramadhan A.H. 642, or the 24th of August, 1227. His son Octai succeeded him, and his two other sons received Transoxiana and Khorasan.

Although his conquests were generally attended by terrible cruelties, he appears to have possessed many of the qualities of a great ruler. Thus he organized a complete postal and police system throughout his empire, tolerated all religions, and ordered that priests and professors of medicine should be exempted from taxation and military service. He also established a code of laws by which the practice of hospitality was made compulsory throughout his dominions, and robbery, murder, adultery, &c., were punished with the severest penalties. This code is still known in Asia.

GE'NII (called in the East *Djinn* or *Jinn*) are supposed to be a race of beings created from fire, capable of assuming any form, and becoming invisible at pleasure. They are said in the Koran (c. vi.) to have been created by God. They are supposed to have possessed the world before the existence of man, and to have lost it for their disobedience to God. Much of the happiness and misery of man is ascribed to them. The word as thus applied is said to have originated in a similarity of sound between the Eastern word *Djinn* and the *Genius* of the Latin mythology. The latter was a guardian spirit, who was supposed to be attached to every object, and to watch over the fortunes of its particular nation or individual. See GENIUS.

GEN'IPA is a genus of plants belonging to the order RUBIACEÆ. The species *Genipa americana* yields a much esteemed fruit, the genipap of the West Indies. It is about as large as an orange, of a whitish-green colour. It is succulent, two-celled, containing many seeds, with a thick rind. The juice is dark purple and of an agreeable flavour. In Dutch Guiana the fruit is called the marmalade box. This species was introduced as a stove-plant in 1779 from South America. The flowers are pale yellow. Other species are also in cultivation. Genipa is very nearly allied to Gardenia, taking its place in the tropics of the New World. There are eight species.

GENIS'TA, a genus of plants belonging to the order LEGUMINOSÆ. The species have yellow flowers, which mostly yield a yellow dye. About seventy species are included in this genus, but few are applied to any important uses. They are found principally in Europe, North Africa, and West Africa; a few are natives of Great Britain. *Genista tinctoria* (dyers' broom) is a native of Europe, and is found in pastures, fields, and thickets in England. The flowers yield a yellow colour, which is much used for dyeing wool. It has also a medicinal reputation. The seeds act as a mild purgative. [See BROOM.] *Genista monosperma* is a native of Spain, Portugal, Barbary, and Egypt. On the shores of Spain it is found to be very useful in binding the otherwise drifting sand, and by its beautiful fragrant blossoms it converts what would be otherwise a barren waste into a garden. Goats feed on the leaves and young branches, of which they are particularly fond.

GEN'ITIVE and **GENITIVAL PHRASES.** The genitive is one of the principal "cases" of grammar, and (except as to pronouns, which have retained their accusatives) the only flexion of nouns in English.

Our true modern English genitive is *s* preceded by an apostrophe, as "John's apple," and as in very many instances the relationship of the first-named noun to the second is, as in that given, one of possession, the case is often loosely called the *possessive* case. But there is no reason for departing from the old term *genitive*, though this term is itself an absurd Latin corruption. In Greek it is *genikê*, the case showing the *genus* or relationship, and in no sense conveying the generating or genitive idea. The true expression in Latin would be *generalis*. However, it matters little at this distance of time what was the original signification, if the exact limits of the term as now used are defined; whereas, to coin a new word "possessive," is mischievous, inasmuch as it conveys a wrong impression, converting a mere majority of instances into a law. There is not the slightest element of possession about "a day's ride," "a life's romance," nor about "the king's murderers."

In our oldest English not only the genitive but all the other cases had their proper flexional case-endings—nominative, vocative, accusative, genitive, dative, and ablative; and probably these case-endings were themselves ancient words, as in the case of our verbal suffixes [see AUXILIARY VERBS], though they are not yet fully traced out. The genitive in Old English ended in *s* or *sya*, which is supposed to be a demonstrative pronoun, the Sanskrit *syas*, *sya*, *tyat* (that). The genitive would thus seem to be the *adjectival* case, which indeed, as we have seen, is its true meaning; and we find, as a fact, that adjectives are constructed from nouns in Sanskrit by the addition of *tya* (=*sya*). So in Greek the adjectival termination for a noun was *-sios;* as *dêmos*, "people," noun, *dêmosios*, "belonging to the people," adjective. And further, since in Greek the first *s* would be elided in the course of the development of that language (as numberless instances show), we get from *dêmosio-s*, *dêmoio*, and hence *dêmou*, the nominative *s*-termination of course falling out. But *dêmou* is nothing else than the regular Greek genitive of *dêmos*. We have very few English examples so clear as these numerous classical ones; but one may point to the *n* in *mine armour* and *golden armour* (the armour *of me* and *of gold*) as an identical suffix. The genitive singular in *es* was not universal in our Old English (or Anglo-Saxon, as it used to be called), but it was so greatly in the majority that the "weak" form of genitive in *n* (as *tungan*, of a tongue, genitive of *tunge*, a tongue) has remained only in the adjectival form wood*en*, gold*en*, &c., and the pronominal forms *mine*, *thine*. The country folk say "his'n, her'n, their'n," to this day, in a vain endeavour to retain the genitival *n*. *Her*, *their*, *your*, *our*, are forms due to a genitival *r*—a genitive of Old English feminine adjectives, both singular and plural, in the "strong" declension. Thus *god tunge* (a good tongue), *godre tungan* (of a good tongue), *godra tungena* (of good tongues), where the noun has the *n* genitive, the adjective the *r* genitive. The genitival case-ending *es* or *'s* has nothing to do with *his*, although our writers, from Ben Jonson to Addison, by a daring piece of folk-etymology, considered it had. They were met by the puzzle of the genitive of feminine nouns, and of plurals also ending in *'s*. Are we to say "Sara's name," meaning "Sara his name?" Or can "men's minds" mean "men his minds?" Such an absurdity was not tolerable to the pedants of Elizabethan times; and accordingly we get such "improvements" as that in the heading of Genesis xvii., "Sarai, her name is changed," &c. A little knowledge of our older speech would have saved them this solecism.

If a noun ends in *s*, *x*, or *g*, especially if it be of more than one syllable, the genitival *s* is frequently omitted for euphony. Thus Shakspeare has "young Paris' face," "a Phœnix' throne," "a partridge' wing," "for justice' sake," &c. The omitted letter is indicated by an apostrophe. By an extension of this custom to the second of the two words we get "river-side," "mercy-seat," &c., when the second word begins with a sibilant. *Now-a-days* and *early days* (as "it is early days for so and so") are examples of a class of genitival phrases now almost all lost. A mode of attaching the genitival suffix to a compound word or phrase has most unfortunately almost vanished. Where we say, "King Richard the Second's reign," our forefathers, down to the Elizabethan times, would have

spoken of "King Richard's reign the Second." So Byron has "For the Queen's sake, his sister" (instead of "for the Queen his sister's sake"), following Shakspeare's use in "It is Othello's pleasure, our noble and valiant general," for "Othello our general's pleasure." This is undoubtedly a finer construction than the ordinary one. In fact, rather than the cumbrous phrase, "It is Othello our noble and valiant general's pleasure," we should probably abandon the English use altogether, and employ the poor French construction, as thus: "It is the pleasure of Othello, our noble, &c." But, happily, so much do we shrink from this insidious change that we even often use a double genitive, where it has irresistibly crept in, as in phrases like "this book of John's," for "this book of John." No one comparing the older form with the newer can fail to see that "the old is better." For instance, who would write, "The rod of the man whom I shall choose" if it were still customary to write, as in Numbers xvii. 5, "the man's rod whom I shall choose?" But the need of clearness has forced the direct racy older speech to yield to the cumbrous substitute.

GE'NIUS, in its original acceptance, denoted the tutelary god or demon which, according to an ancient superstition, was allotted to every individual at his birth to guide him during life, to preside over his fortunes and destiny, and eventually to lead him from existence; and it was supposed that the variety observable in the characters and capacities of different men was dependent upon the higher or lower nature of their attendant genii. Afterwards the word came to signify the disposition itself, without reference to its supposed cause; and lastly, in modern times it has been employed, in a restricted but peculiar sense, to designate either that high mental pre-eminence which is occasionally found in a few individuals, or, by a metonymy, the person possessed of such rare excellence.

GENLIS, STÉPHANIE FÉLICITÉ, COMTESSE DE, was born near Autun in 1746. Her musical skill introduced her to some persons of distinction, and the elegance of her first writings attracted the attentions of the Comte de Genlis, who married her. Subsequently the education of the children of the Duke of Orleans was intrusted to her care; one of them, Louis Philippe, was afterwards king of the French. Some works written for her pupils are still popular. During the French Revolution the Comtesse de Genlis was obliged to flee from France, and went successively to England, Belgium, Switzerland, and Hamburg, followed everywhere by the suspicions which her avowed sentiments, her connections with several leading revolutionists (among others with Lord Edward Fitzgerald, who married her adopted daughter Pamela), and the slander of the royalist emigrants, raised against her. At Hamburg she wrote a kind of political work styled "Les Chevaliers du Cygne," and afterwards attempted a justification of her own conduct and sentiments, "Précis de la Conduite de Madame de Genlis." She returned to France under the consulship of Bonaparte, who had a favourable opinion of her talents, and she became one of his admirers and panegyrists.

After the Restoration she wrote in defence of monarchy and of religion. When she was past eighty years of age she wrote her memoirs; but as she was naturally ill-natured, factious, and inaccurate, they are not of much value. She lived to see the events of July, 1830, and her former pupil raised to the throne. She died on the 31st December, 1830, aged eighty-four.

Madame de Genlis wrote numerous novels, of which "Mdlle. de Clermont" is the best.

GEN'OA (*Genova*), a province of Italy, is bounded N. by Parma and Piedmont; E. by Parma, Pontremoli, and Massa; S. by the Gulf of Genoa; and W. by Coni. The length along the coast is 120 miles, the width of the territory at Savona is about 6 miles, at Genoa 25, and at Chiavari 44. The area is 1588 square miles, and the population amounted in 1882 to 787,215.

The coast presents numerous indentations, and has several good harbours and two spacious bays—those of Rapallo and Spezzia, which last was called by the Romans *Portus Lunæ* (Persius, "Sat." vi. 9). The Apennines cover the greater part of the surface of the duchy, curving round the gulf at the distance of a few miles from S.W. to N.E., and forming two slopes, from the northern of which descend the Bormida, the Orba, the Scrivia, the Staffora, and the Trebbia, all feeders of the Po; while the Gulf of Genoa receives from the southern slope the Centa (called in its upper course the Aroscia), the Polcevera, the Besagno, the Sturla, the Vara, and the Magra. The soil, with the exception of a narrow strip along the coast, is in general not fertile; a great part of it consists of bare and arid rocks; there are, however, extensive forests and fine pastures on the mountain slopes. The industry of the inhabitants has turned to advantage every spot capable of cultivation, but the produce is not equal to the consumption. The chief products are wine, chestnuts, oil, silk, cotton, hemp, citrons, oranges, lemons, figs, pomegranates, almonds, and other fruits. The aloe flourishes. Marble, alabaster, slate, limestone, asbestos, and coal are found; a good deal of salt is made along the coast. The climate is temperate and salubrious, and the air remarkably pure; the winds in winter, however, are bitter cold in the mountain ravines, and the sirocco sometimes exerts its noxious influence. The island Galinara, opposite the mouth of the Centa, those of Palmaria and Tino, at the entrance of the Bay of Spezzia, and that of Capraja, near Corsica, belong to the province of Genoa. An excellent road, disclosing innumerable views of the most picturesque beauty, runs along the Riviera di Ponente (western shore) from the city of Genoa to Nice, and along the Riviera di Levante (eastern shore) from Genoa to Sarzana.

The Genoese are a robust, good-looking people, active and industrious; they speak a dialect of Italian, most difficult for a stranger to comprehend. The principal occupations, besides those indicated above, are trading by sea, fishing, and manufactures of jewelry, velvet, embroidered cambrics and muslins, cloth, furniture, both plain and ornamental, &c. The costume of the women is singularly graceful.

GENOA, the capital of the above province, is situated at the foot of the Ligurian Apennines, in a recess of the Gulf of Genoa, 75 miles south-east from Turin. It stands partly on the declivity of several hills rising in the form of a semicircle round the spacious harbour, and partly on a narrow strip of ground between them and the sea. It is inclosed on the land side by a double line of fortifications, the external one being above 8 miles in length. The higher Apennines rise immediately behind. As a protection on the harbour side, a breakwater 2200 metres long was, in 1874, thrown across the mouth of the gulf, and raised to within 4 or 5 feet of the surface of the water. The harbour is terminated at either extremity by two piers, the Molo Vecchio and the Molo Nuovo; on the latter is a beautiful lighthouse tower 300 feet high. The appearance of Genoa from the sea is truly magnificent, and justifies the title of *La Superba* bestowed upon it. A succession of fine buildings more than 2 miles in length lines the shore; numerous palaces and gardens, churches and convents, rise behind like an amphitheatre on the steep sides of the hills that rear their dark and barren summits above. The buildings are square and lofty, and the roofs are covered with light-coloured slate, which has a neat and pleasing effect. The interior of the town is not so pleasant, many of the streets being very narrow, crooked, dark, and steep. A fine new street in the modern style, the Via Roma, was opened in the heart of the city in 1877. The streets Balbi, Nuovissima, Carlo Felice, Carlo-

Alberto, and Nuova, are entirely lined with marble palaces, some of which have galleries of paintings and magnificent internal decorations and furniture. The palaces Serra, Durazzo, Doria, Tursi, Doria Pamfili, Brignole, Brignole Rosso, and Spinola, are among the most remarkable. Genoa has many handsome churches. The Cathedral of San Lorenzo (said to have been first founded in the time of St. Lawrence, but certainly several times added to and altered, if not entirely rebuilt, since that period) is very rich in artistic work, especially the chapel of St. John the Baptist. In the cathedral is an octagonal bowl that was brought from Cæsarea in 1101, and resembling the "Holy Grail." It was long thought to be made from a priceless emerald, but being broken turned out to be composed of ancient glass. The Church of l'Annunziata, the elegant churches of Santa-Maria di Carignano, San Siro (originally the Cathedral of Genoa), San Matteo, and Sant' Ambrogio are interesting edifices. The Loggia de' Banchi, where is the exchange; the ponti or quays of the harbour; the Porto Franco or free-port warehouses, where goods can be deposited and re-exported without paying duty; the Goldsmiths' Street (Strada degli Orefici), the Compera or Banco di San Giorgio (St. George's Bank), the theatre Carlo Felice, the promenade of L'Acquasola, the great hospital, and the former palace of the doges (Palazzo Ducale), are all worthy of notice.

Genoa is the seat of an archbishop; it has a university, naval schools, royal college, hospital, lunatic asylum, orphan asylum, home for the poor, communal schools, an institution for deaf-mutes, an academy of fine arts, and public libraries. It has a spacious dry dock and large ship-building yards. The harbour has been improved of late years, and extensive bonded warehouses erected. There is regular communication by steamers with Marseilles, Barcelona, Leghorn, Civita Vecchia, &c., and Genoese vessels trade to the Levant, the Black Sea, the Baltic, to America, and even to the Pacific. It has also good railway accommodation. The value of the exports is about £3,000,000 per annum, and of the imports £14,000,000. The combined arrivals and departures of vessels to and from the port are nearly 12,000 per annum. The principal articles of export are silk, rice, hemp, oil, and paper; the imports consist chiefly of petroleum, fish, coffee, cotton, and coal. There are at Genoa manufactories of cotton, silk stuffs, velvet, and woollens, jewelry and fancy articles, musical instruments, canvas, cordage, paper, and iron.

The Bank of St. George, in Genoa, was the oldest bank of circulation in Europe, having been founded in 1407. It was conducted by a company of shareholders, and having gradually advanced immense sums to the government, a large proportion of the public revenue was assigned to it in payment of the interest. On the invasion of Genoa by the Austrians in 1746 a part of the treasure of the bank was carried off. Finally, on the union of Genoa with France the bank was suppressed, the government of France becoming responsible for an annual dividend of 3,400,000 Genoese livres payable to its creditors. A new bank was formed in 1844. The population of Genoa in 1882 was 179,515.

Columbus is said to have been born near this, at Cogoleto, in 1459, and a handsome monument has been erected in Genoa to his memory.

History of Genoa.—The origin of Genoa, or *Genua* (its Roman name, meaning "knee," or as we should now say, "elbow," the shape of the shore), is lost in the obscurity of old traditions, which would assign to it an antiquity greater than that of Rome. It is mentioned by Livy at the beginning of the Second Punic War, when it was taken by Mago, the Carthaginian general, and partly destroyed, but it was soon afterwards restored by an order of the Roman senate. Strabo mentions Genoa as an emporium of the Ligures. After the fall of the Western Empire, Genoa was taken by the Longobards in 641. Charlemagne afterwards placed it, with all maritime Liguria, under the government of a count. During the contests about the crown of Italy between the German emperors and other claimants, the citizens of Genoa asserted their independence, and were governed by elective magistrates styled consuls. The names of the consuls began to be recorded from the latter part of the eleventh century. At that time the Genoese had already rendered themselves formidable by sea; aided by the Pisans, they drove the Saracens out of Corsica, Capraja, and Sardinia, between 1016 and 1021. They took part in the great crusade under Godfrey de Bouillon, and obtained settlements on the coast of Palestine, especially at Acre. In 1146 the Genoese turned their arms against the Moors, from whom, during this and the following two years, they took the island of Minorca and the Spanish cities of Almeria and Tortosa. These conquests excited the jealousy of Pisa. Four wars took place between the two states, from 1070 to 1282, in which last year the Pisans were completely defeated by sea near the rocks of Meloria, in sight of their own coast, when 3000 Pisans were killed and 13,000 taken prisoners to Genoa.

The rivalry between Genoa and Venice began soon after the conquest of Constantinople by the Franks in 1244. The Genoese, having assisted Michael Palæologus to reconquer his capital, obtained from him the suburbs of Pera and Galata and the port of Smyrna, with full jurisdiction over those places. They also established numerous colonies and factories on the coast of the Black Sea. The Venetians disputed with them the supremacy of the Levant seas, but after several naval fights the two powers concluded a truce in 1271. After the fall of Pisa the Genoese renewed the conflict with Venice. It lasted with varying success till 1381, when the Genoese, having taken Chioggia and besieged Venice, were themselves, by the efforts of Vettor Pisani and Carlo Zeno, blockaded in Chioggia, and forced to surrender. From that time Venice and Genoa remained at peace, with trifling interruptions. Genoa was exhausted by internal factions. To the rule of the consuls had succeeded, about 1190, that of the Podestà, renewed annually, and who were chosen from among the citizens of another state. This lasted, with some interruption, till 1270, when two citizens, Oberto Spinola and Oberto Doria, distinguished for their services, usurped the supreme power under the name of "captains of liberty," which they retained till 1291. In the early part of the fourteenth century the Guelph and Ghibeline struggle desolated the country. In 1339 the citizens, weary of discord and disorder, instituted a supreme magistrate, called Doge, for life, excluding by law all the nobles from the office. This lasted two centuries, but not without frequent contentions. The neighbours of Genoa, the visconti of Milan, and the kings of France, taking advantage of these feuds, at various times obtained possession of Genoa. At last, Andrea Doria had the merit of delivering his country from the French yoke; and in order to avoid a recurrence of the former feuds he changed the institutions of the country, by establishing biennial doges and councils to assist and control them. This aristocracy, however, was not wholly exclusive, like that of Venice; new families might be added to it at certain times and with certain qualifications. This form of government lasted from 1528 till Bonaparte's invasion of Italy. Under the influence of France, indeed by her command, a democratic constitution was formed, protected by a strong French garrison within the town. In 1799 the French, under Massena, were besieged within Genoa by the Austrians and the English, and after a most gallant defence the town capitulated to the Austrians, but was again given up to the French after the battle of Marengo. Bonaparte, then consul, gave a new form of government to Genoa; but when he became emperor he required, in 1805, its formal annexation to France, to which requisition

the Doge Durazzo gave his official consent, and expressed the wish of the people "to be united to the great empire." In 1814 Genoa surrendered to the English forces under Lord William Bentinck, and in the following year, by a decision of the Congress of Vienna, it was united to the Italian (then the Sardinian) monarchy, under which it yet remains. For further particulars of the history of Genoa a most interesting book, "How the Republic Rose and Fell," by J. T. Bent (London, 1881), may be referred to.

GENRE is the not very happily chosen name of a kind of painting aiming at the representation of actual persons and things, rather than at expressing lofty ideals by the medium of art. The word means class, and originally divided the various classes of paintings, as *genre classique*, *genre historique*, &c. It is now limited both abroad and here to the signification given above. Domestic and rural figure paintings lend themselves readily to the genre style, and one of the great schools, the Dutch school (including the Flemings), raised genre-painting to almost high art by the wonderful excellence of manipulation displayed. Wilkie, Nicol, and our other humorous painters of course prefer the genre style, their figures being almost copies of the actual rustics delineated; a poetical or ideal treatment would destroy the fun. The greatest master of our day, or of any day, in this style is Meissonier, and his exceedingly costly canvases exemplify another characteristic of genre besides actuality and love of detail, namely, the usually very moderate size of such pictures.

A similar school has lately shown itself in literature and the drama, led by Anthony Trollope and F. W. Robertson in England, and by Zola and Sardou in France.

GENS, GEN'TILE. Gens was the name of that association of families into a kindred which so remarkably distinguishes the polity of ancient Rome. The word would imply an absolute relationship as far as its own proper meaning is concerned, for it is nothing else than the word which in Greek is *genos*, in Old English *cynn* (kin), and so on through the Aryan family of languages, the assumed Aryan root being $\sqrt{}$GAN. The chief name (*nomen*) of a Roman was his gentile name, the name of his gens. The great Julian gens had a family of Cæsars within it; the Cornelian gens had one of its families called Sulla, another called Scipio; and individuals of these families would be all called Julius Cæsar, Cornelius Sulla, Cornelius Scipio, &c. (The relation of a family to a gens may be paralleled in our Scottish clans; thus we find the families of Argyle, Breadalbane, &c., in the great clan Campbell, and so forth). To distinguish among individuals of these families a third name, the *prænomen*, was necessary; and so we get the familiar Caius Julius Cæsar and Lucius Julius Cæsar, Lucius Cornelius Sulla, Publius Cornelius Scipio, &c. The family name was sometimes absent, but of course the personal name was always necessary, answering to our Christian name; and equally necessary, probably more so in the eyes of a Roman, was the gentile name, *the* name par excellence.

But whereas family names (like English surnames) are nearly all easily accounted for by personal peculiarities, as *Torquatus* (the man with the chain), *Maximus* (the celebrated), *Brutus* (the dullard), *Cicero* (the warty man), &c., the gentile names resist all etymological solvents. The decision of scholars therefore now is that probably the *gentes* originally were separate clans or tribes, and that the union of these made the infant state of Rome, rather than patriarchal communities, veritably descended each from a common ancestor, as was the actual belief of the Romans themselves. This view is borne out by a consideration of the artificial symmetry of the Roman state. This was divided into three tribes—the Ramnes, adherents of Romulus; the Tities, adherents of Titus Tatius, the Sabine king, who joined him; and the Luceres, followers of the Etruscan king, Lucus. Each of these contained ten gentes, those of the Luceres being called *gentes minores*, a distinction involving very little more than that in the senate, the *gentes majores*, voted first, &c. Each tribe (*tribus*, third part) was divided into ten wardships or *curiæ* (*curare*, to keep ward), and each *curia* into ten clans or *gentes*, each gens into ten households or families, contributing its foot-soldier to the general army. As 1000 soldiers would thus represent the fighting power of the tribe, we see the origin of the *mil-es*, the thousand-man or soldier of Rome; 3000 men formed the entire primitive army. Each gens sent its horseman or knight, 100 for each tribe, 300 for all Rome; and the senate of 300 was formed in the same way. Of course this exact symmetry afterwards was broken into considerably; but that it existed, and existed for a long time, militates greatly in favour of the view as to the origin of the gentes shadowed forth above.

At stated times during the year the priests or pontiffs (*pontifices*) summoned the gens to perform certain rites, and attendance at these by sufficient representatives of each family was rigidly enforced, probably with a view, among other things, of keeping together the clan-feeling of the gens. With the same view it was a fundamental law of the state that the property of a Roman dying intestate devolved upon his gens, which possessed in this way a common fund for gentile emergencies. It is evident from the mode of formation of the gentes that no plebeian could have a gentile name except in those few instances (as in the Cornelian gens and some others) where a gens had plebeian as well as patrician families. For many centuries therefore the nobility of the Romans were absolutely and clearly marked off from the "new men," however talented or respected the latter might be. In no other community was care of descent and pride of birth so much a part of the very inmost constitution of things as in republican Rome. See GENTLEMAN.

When, therefore, it was desired to mark off the Jewish from the other converts (or possible converts) to Christianity, no other term seemed so well fitted for the non-Jewish communities as gentile. The gentiles, the people who belonged to a Roman gens, or who were affiliated to it, or were its hangers-on or its acknowledged clients, the clansmen of the empress of the world, these men of various tongues and races, yet all united by the mysterious ancient bond, could be set in a mass against the "peculiar people," who held jealously aloof from the all-devouring Roman domination, cowed by it though they were, crushed by it though they were to be. Jews and Gentiles (though the first were as a drop in the ocean of the latter) divided the world in the eyes of the apostles.

GEN'SERIC, King of the Vandals, was the natural brother of Gonderic, whom he succeeded in 429. In the same year he left Spain, and crossed over into Africa at the solicitation of Bonifacius, the Roman governor of that province, who had been induced, by the arts of his rival Aetius, to rebel against Valentinian III., emperor of the West. Bonifacius soon repented of the step he had taken; but his repentance came too late. The Moors joined Genseric, and the sect of the Donatists, who had been persecuted by the Catholics, assisted him against their oppressors. Bonifacius was obliged to retire into Hippo Regius (the modern Bona), which, however, he abandoned to the barbarians, and sailed to Italy. A peace was concluded in 435 between Genseric and the Emperor of the West, by which all Africa to the west of Carthage was ceded to the Vandals. Notwithstanding the peace, the city of Carthage was taken by the Vandals by surprise in 439.

Genseric with a powerful fleet now ravaged the shores of Sicily and Italy. Invited by the Empress Eudoxia, he sailed up the Tiber in 455, and permitted his soldiers, for the space of fourteen days, to pillage Rome. In 460 he destroyed the fleet which the Emperor Majorian had collected for the invasion of Africa. Sardinia was conquered,

and Spain, Italy, Sicily, Greece, Egypt, and Asia Minor were plundered every year by the Vandal pirates. Leon, the emperor of Constantinople, at last sent a large army for the recovery of Africa, and the command was given to Basilicus. He landed at Bona, and at first met with considerable success, but was at length obliged to retire from the province. Genseric remained undisturbed master of the sea till his death, which happened in 477. Genseric was an Arian, and persecuted the Catholics.

GENTIA'NA, a genus of herbaceous plants, giving their name to the order GENTIANEÆ, remarkable, as ornamental objects, for the brilliant colours and beautiful forms of their flowers, and most useful in medicine on account of the pure intense bitter which they all contain. The species are extremely numerous (about eighteen), inhabiting the temperate part of Europe, Asia, and America, chiefly in mountainous situations, where they breathe a pure and rarefied air, are exposed to bright light during the short summers of such regions, and though fixed during winter in places intensely cold, yet are so well protected by the snow that covers them as to suffer no injury. These alpine plants are consequently difficult to cultivate, from the impossibility of imitating their natural atmosphere; and hence it is only a very small number that are ever seen in gardens. Most of the species have blue flowers, but some have yellow, white, or red flowers; the latter are almost confined to the Andes.

The ornamental species that are found suitable for cultivation are *Gentiana lutea*, with yellow flowers, and *Gentiana asclepiadea*, *Saponaria*, *Cruciata*, *septemfida*, *acaulis*, and *Pneumonanthe*, with blue flowers. Of these all require a good American border of peat-earth to grow in, with the exception of *Gentiana acaulis*, which prefers the hardest and stiffest clay. For medical purposes the root of *Gentiana lutea* is principally collected.

Gentiana lutea is a perennial species, common in the mountainous and subalpine districts of Switzerland, Germany, &c. Though the whole plant is bitter, yet, as this property is most concentrated in the root, that part only is officinal. This should be taken up in autumn, and is best when the plant is only one year old. It is generally cylindrical, often an inch thick at the summit, but below rather branched, of a dark or brown colour externally, internally fleshy and yellow. In commerce it is met with in pieces, cut longitudinally, from half a foot to a foot in length. A transverse section displays three distinct circles. The greater portion is procured from Germany; the specimens from Switzerland are generally thicker and darker coloured. When fresh it has some smell, which is almost entirely lost by drying. The taste is at first somewhat sweet, then purely and strongly bitter.

Yellow gentian-root is often confounded with the roots of other species of this genus, a circumstance attended with no bad consequences; but unfortunately roots of very poisonous plants, growing in the same locality, are often taken up instead of the proper one; these are the *Veratrum album* (white hellebore) and the *Atropa Belladonna* (deadly-nightshade). The roots of *Aconitum Lycoctonum* and *Ranunculus Thora* are occasionally confounded with gentian-root. Gentian-root is a pure and excellent bitter tonic, useful in all cases of debility, whether of the stomach only or of the system generally. It possesses facilities, from not becoming decomposed, of being administered with many metallic salts. It yields its properties to water, particularly when warm, to alcohol, and to wine. It is received in pieces varying from a few inches to more than a foot in length and from a half to 2 inches thick. In the Tyrol a spirit is obtained from an infusion of the root.

GENTIA'NEÆ, an extensive order of GAMOPETALÆ consisting of herbaceous plants. The flowers of these plants are usually coloured with pure bright yellow, red, or blue, and in many cases they are on this account among the most beautiful of flowers. This order is famous for its bitterness, which seems to pervade all the species. Gentiana itself furnishes all the officinal kinds, but *Erythræa Centaurium* (centaury), common in many parts of England, is advantageously employed by country people as a substitute; and the root of *Frazera carolinensis* has been used as a means of adulterating the bitter calumba-root. The order Gentianeæ is classed by Bentham and Hooker in the Gentianales, a cohort of gamopetalous dicotyledons. [See BOTANY.] The corolla lobes are generally four or five; the stamens of the same number and alternate; the style simple, with bifid stigma; the ovary generally one-celled, and placentas parietal (except in Exacum); the leaves are opposite and ribbed.

GENTIAN'IC ACID or **GEN'TIANIN.** This is an organic acid obtained from the root of gentian (*Gentiana lutea*), natural order Gentianaceæ. It crystallizes in needles and is soluble in water, but more soluble in alcohol and ether. It may be heated to 200° C. (392° Fahr.) without change, but at 300° C. (572° Fahr.) it sublimes in yellow needles. The acid is tasteless when pure, and is neutral to vegetable colours, but it decomposes alkaline carbonates, and forms a series of salts called gentianates. The formula is $C_{14}H_{10}O_5$.

GENTILE, any person of whatever nation not a Hebrew. See GENS.

GENTLEMAN, a corruption of French *gentilhomme*. Some form of this word (a compound of *gentilis* and *homo*) is found in all the Romance languages (*gentil-homme* in French, *gentil uomo* in Italian, and *gentil-hombre* in Spanish), one of the many traces of the ancient polity of Rome. [See GENS.] The privilege of succession, which was called *jus gentilitatis*, or simply *gentilitas* (Cic. "De Oratore," i. 38), and formed one of the enactments of the twelve tables, was gradually undermined by the encroachments of the prætors on the civil law, and finally disappeared (Gaius, iii. 25); but the name of gentle (gentile) man has survived in all the languages of Western Europe which are derived from the Latin, or have received large additions from it.

According to Selden ("Titles of Honour," p. 852), "a gentleman is one that, either from the blood of his ancestors, or the favour of his soveraigne, or of those that have the vertue of soveraignte in them, or from his own vertue, employment, or otherwise, according to the customes of honour in his country is ennobled, made gentile, or so raised to an eminencie above the multitude, that by those lawes and customes he be truly nobilis, or noble, whether he have any title, or not, fixed besides on him."

In a narrower sense, a gentleman is generally defined to be "one who, without any title, bears a coat of arms, or whose ancestors have been freemen; and by the coat that a gentleman giveth, he is known to be, or not, descended from those of his name that lived many hundred years since." There is also said to be a gentleman by office and in reputation, as well as those that are born such (2 "Inst." 668); and according to Blackstone, quoting Sir Thomas Smith (1 "Comm." p. 406), "Whosoever studieth the laws of the realm, who studieth in the universities, who professeth the liberal sciences, and (to be short) who can live idly and without manual labour, and well bear the port, charge, and countenance of a gentleman, he shall be called master, and taken for a gentleman." In the highest sense the term signifies a man who not only does what is just and right, but whose conduct is guided by a true principle of honour, which springs from that self-respect and intellectual refinement which manifest themselves in easy and free yet delicate manners.

GENTLEMEN-AT-ARMS, the body-guard of the sovereign, and the oldest corps but one in the British service. It consists of a captain, lieutenant, standard-bearer, clerk of the cheque, forty gentlemen-at-arms, and the harbinger. The corps was first instituted by Henry VIII.

and composed only of gentlemen of noble blood. It then received the appellation of gentlemen pensioners; but in 1834 the name was changed to that of gentlemen-at-arms. The pay of the captain is £1000 a year; the lieutenant, £500; the standard-bearer, £310; the forty gentlemen-at-arms, £70 each; the clerk of the cheque, £120; and the harbinger, £70; making a total of £4800. The pay is issued from the privy purse. The gentlemen-at-arms attend at drawing-rooms, levées, coronations, and other state ceremonies. The appointment is in the gift of the crown, on the recommendation of the commander-in-chief, and cannot be held at the same time with any other office which might involve absence at the time of the officer's services being required by the sovereign.

GENUFLEX'ION is the act of bending the knees or kneeling in worship. The English Church prescribes the kneeling posture during all times of prayer, and this, combined with the practice of bowing the head at the name of Jesus, has from Puritan times been the subject of much controversy. In the Roman Catholic Church kneeling is employed during the mass, and in the presence of the consecrated elements, as the highest form of worship.

GE'NUS signifies a multitude of objects which possess some common quality or qualities; in formal logic it denotes the material part of the definition, which is *per genus et differentiam*, the difference being the distinguishing mark of the special kind or species. Every object has a great variety of characters and qualities; and in several objects we observe many points of agreement and difference. We are enabled to consider these mutual relations and resemblances without any regard to their differences; we, as it were, draw the one away from the other; we abstract them.

Now by abstraction we may either confine our view to a quality inherent in some object, independently of that object, or else, neglecting the many points of disagreement which exist between a number of objects, we may seize upon the qualities that belong to all in common, in order to combine them into a single idea. In the former case the notion is simply abstract, in the latter it is abstract and general; and the multitude of objects to which we apply the general notion or common term constitutes a *genus*.

We may proceed in this way to neglect in succession a greater number of differences, and to comprise under the common denomination fewer points of agreement and resemblance. In this manner we form a series of notions or genera of higher and lower order, until we ultimately arrive at the highest possible—that of *being*. In this co-ordination of classes each class is called a species in respect of the higher class, but a genus in respect of the lower class; and that which is not contained under any higher is called the *summum genus*, and that under which individuals only are comprised is usually called the *infima species*. Man, animal, organized being, material body are various grades; man being the *infima species*, and animal a genus with reference to man, and a species with reference to organized being.

In natural history the gradations are so numerous that the terms species and genus are given to the two lowest grades, and special terms invented to designate the higher grades. Species is always applied to the *infima species*, and genus is invariably the next grade. In zoology and botany the name of the species consists of two parts, the first being the name of the genus; thus the wood anemone is called *Anemone nemorosa*, anemone being the genus to which this species belongs. These general notions and genera are the principles of classification and arrangement, and without them the knowledge of facts would be a confused mass of conceptions and objects without order or coherence.

GEOCEN'TRIC (having the earth as centre), a term applied to the place of a planet, as seen from the centre of the earth, in opposition to its *heliocentric* place, as seen from the centre of the sun. Latitude and longitude also may be either heliocentric or geocentric. The geocentric longitude of a planet is the angle included between two planes, both passing through the earth's centre (geocentric) and at right angles to the ecliptic; and one passing through the planet's centre, while the other passes through the first point of Aries. The geocentric latitude of a planet is the angle made by a line joining the earth and the planet by their centres, with the plane of the ecliptic.

GE'ODES (Gr. *geodes*, earthy) is a geological term applied to nodules having a hollow interior surrounded by crystals.

GEOD'ESY, the art of measuring the earth. It is a convenient general term for the variety of geometrical and trigonometrical processes by which the earth's surface is surveyed, and hence, by adding certain astronomical facts, its figure determined. Geometry (earth-measurement) would be by its etymology the true term for this art, but geometry has long since received another connotation. No doubt it originally meant what its name implies. Geodesy is made up from *ge*, the earth, and *daiô*, I divide. In geodesy great care has to be paid to the expansion and contraction of metals, and the varying effects of refraction due to the atmosphere under altering conditions. Many measurements have therefore to be made, and their mean taken, before any certainty can be arrived at. The first problem of geodesy is the determination of a BASE LINE, and the extreme caution necessary in this is fully detailed in the article under that head.

GEOFFREY OF MONMOUTH, the well-known British historian, was born in the town from which he took his name, and is supposed to have received his education at the Benedictine monastery in its vicinity. He was made archdeacon of Monmouth, and in 1152 consecrated bishop of St. Asaph's. Robert, earl of Gloucester, natural son of Henry I., and Alexander, bishop of Lincoln, were his chief patrons.

Walter Calenius, archdeacon of Oxford, a diligent inquirer for his day after the works of ancient authors, is said, whilst journeying in Armorica, to have met with a history of Britain written in the British tongue, the translation of which, upon his return to England, he recommended to Geoffrey of Monmouth, who undertook the task and completed it with great fidelity. Geoffrey afterwards added the book of Merlin's "Prophecies," which he had also translated from British verse into Latin prose. Notwithstanding its fabulous and trifling stories, Archbishop Usher, Leland, and others consider that parts of the history are true. Geoffrey was no more a sober chronicler, though he adopted the forms of the chronicle, than Macpherson was a genuine translator of Ossianic poems. Nevertheless he doubtless worked upon some sort of substructure. He gives us a wonderful series of British kings from Æneas and his great-grandson Brut down to Cadwallo, who died in 689. It is to him that we owe the great myth of King Arthur, which has given us our nineteenth-century epic, and that of Gorboduc, which inspired our first tragedy; it was in Geoffrey of Monmouth, too, that Shakspeare found King Lear. His romance of Arthur so stirred the spirit of men of the time that he received the sobriquet of Arturus. His history in its final form appeared in 1147 in twelve short books; by 1155 Wace had translated it into the 15,000 lines of his poem in Norman-French, the "Brut;" and forty years afterwards Walter Map added those spiritual legends of the Holy Grail, the death of Arthur, and the Lancelot, which have finally given to us the complete mythical Arthur as we now have him. The best Welsh critics seem to consider that Geoffrey's work was a vitiated translation of a "History of the British Kings," written by Tyssilio, bishop of St. Asaph's, who lived in the

seventh century. A translation of it into English, by Aaron Thompson, of Queen's College, Oxford, was published in London, 1718, in 8vo. Geoffrey of Monmouth died about the year 1154.

GEOFFROY ST. HILAIRE, ETIENNE, a distinguished French biologist, was born at Etampes in 1772, and was originally trained for the church. Falling in with some distinguished naturalists, the true bent of his mind disclosed itself. He soon abandoned his college ties; but while himself adopting the new ideas of the time he kept up friendly relations with his old clerical instructors, and thus was so highly fortunate as to be able to rescue one of them, M. Haüy, from the very jaws of the horrible September massacre which defiles the great Revolution with its gory stain. Geoffroy St. Hilaire took service under the Republic as assistant at the Jardin des Plantes, quickly rising to a professorship of zoology and to the care of what specimens and animals there were. He at once set to work to found a proper and systematic zoological collection, calling to his aid among others Cuvier, a young man but three years older than himself, and already locally famous. These two, only twenty-three and twenty-six respectively, raised the Jardin des Plantes to a considerable zoological reputation. Some travelling collections fortunately fell into the hands of the government, their owners being "suspect," and with these Geoffroy further enriched his menagerie. He went with Napoleon to Egypt in 1798, as naturalist to that famous expedition, and did not return empty-handed for his cherished cages and drawers. His brilliant labours carried him to the Academy of Sciences amid universal applause in 1801. His wide acquaintance with zoology, still further extended by a predatory expedition to Portugal in 1808, charged by the despotic emperor to make good any gaps in the French collections from those of that country, led Geoffroy St. Hilaire to the enviable distinction of first propounding the doctrine of the mutability of species. He was thus one of the precursors of the illustrious Darwin. His opponent was his old friend and associate Cuvier, and the splendour of the latter's attainments was so great and his authority so predominant that he was able curtly to dismiss, almost without discussion, views which we now see to have been the true ones. Cuvier pointed to the Egyptian mummies and paintings as evidences that types of men and animals were unchangeable; Geoffroy St. Hilaire, and Lamarck with him, replied that the Egyptian period was far too short for the accomplishment of the slow changes they saw to have been the means of alteration of structure. Geoffroy boldly asserted, in the discussions hotly waged with Cuvier in 1830, that the animals now living are descended, by unbroken series of generations, from the extinct races of the antediluvian age, a view peremptorily pronounced absurd by his opponent. Some bitterness existed for a time between the two rival theorists. Geoffroy St. Hilaire became blind towards the close of his life, and with the partial withdrawal from activity he was able to allow the fever heat of discussion to cool; and it is pleasant to know that his scientific career closed as it began, in warm friendship with Cuvier. He died at Paris, esteemed by all, in 1844. His "Principes de la Philosophie Zoologique" (Paris, 1830) give an excellent account of his side in the great discussion. His other chief works are the excellent "Philosophy of Anatomy" (1820), "Notions of Natural Philosophy" (1838), and his "Mammalia" (1842), &c.

ISIDORE GEOFFROY ST. HILAIRE (1805–61), his son, was a worthy successor of his great father, whose general views he fully adopted. In 1837 he completed the important work "Anomalies of Organization in Men and Animals, or Teratology," by which he is best known. This is an almost exhaustive account, for the time, of malformation and monstrosities and the principles regulating their appearance. Perhaps his most useful work, however, was the foundation of the famous and still flourishing Acclimatization Society of Paris. Of those travellers who go from the menagerie of the Jardin des Plantes to the large lawns and paddocks of the Jardin d'Acclimatation few stop to think that they are due to the energy and devotion of two men, father and son. The object of the Acclimatization Society is to ascertain what animals are suitable for domestication in France. Accordingly, in their spacious gardens herds of graceful animals roam naturally, fish and water-birds have pleasant streams and lakes wherein to live, goats have the rocky peaks they love for a habitation—in short, the habits of each kind are fully studied, and the visitor has none of the painful feeling which caged lions and tigers seldom fail to produce. To keep an animal in a caged unhappiness would be foreign to the aim of the society; no more restraint than is absolutely necessary is therefore allowed. The work of Isidore Geoffroy St. Hilaire, setting forth the principles of "Domestication of Useful Animals," came out in 1854, and is still an exceedingly interesting and practically useful book. He was frequently experimenting on new foods formed of the flesh of various animals from the gardens, and was one of the most ardent advocates of horse-flesh as a wholesome meat, and one which was available for reducing the price of meat to the poor. He did not succeed in altogether overcoming the prejudice against the food, finding it much easier to get well-to-do sensible persons to eat it than those to whom, were it not for the violent prejudice engendered of ignorance, it would be of inestimable service. Yet many horse-butchers started, and still flourish in Paris. His "Histoire Generale des Règnes Organiques," begun in 1852, he did not live to finish.

GEOGRAPHY, according to the simple derivation of the word, means a description of the earth. Practically, however, it is limited to a description of the earth as an inhabited world—first, as a member of the solar system; secondly, as marked out and influenced by natural causes; and thirdly, as split up into artificial divisions by its inhabitants. To that branch of geography which deals with the earth as a member of the solar system, the term mathematical or astronomical geography is given. It embraces an account of its constitution and motions as a planet, and the effects produced thereby on the welfare of man; of the instruments and calculations necessary for the purpose of taking advantage of these effects for practical purposes; and of the means and methods of keeping a permanent record of the results thus obtained, or the construction of charts and maps.

Physical geography covers the second branch. It describes the earth as it is divided by natural barriers of sea, river, mountain, plain, or valley; it groups the various organic families inhabiting the surface according to natural distinctions, without reference to political or historical divisions. It embraces instruction in sufficient astronomy, geology, mineralogy, chemistry, and physics to explain the more general processes affecting the constitution of the earth, and enough of botany, zoology, and ethnology to understand the relationship of the various living organisms.

The third branch is known as political geography, and gives an account of the arbitrary separation of the world into continents, empires, states, cities, oceans, seas, and other convenient divisions. It includes a description of their extent, population, government, commerce, manufactures, resources, and language.

Herodotus, the father of history, is likewise the father of geography. His geographical descriptions are short and general, but always clear, and sufficient to show how far the physical peculiarities of each country influenced the changes and events which he had undertaken to commemorate. Eratosthenes availed himself of astronomical

means for determining the position of places on the earth's surface. After the writings of Polybius and the travels of Posidonius, Strabo, a native of Asia Minor, who wrote in the time of Augustus and Tiberius, undertook to incorporate in one work those scattered materials, and to add the information which he had acquired in his own travels. The work so produced is one of the most valuable books left to us by the ancients. While the geography of Strabo was extensively used all over the Roman world, the astronomical school of Alexandria continued collecting materials for the purpose of completing and perfecting the system of geography framed by Eratosthenes. These collections enabled Ptolemy to form his geography, which is hardly anything more than a catalogue of places according to their estimated or determined geographical position, but contains much valuable information.

The downfall of the Roman Empire suddenly extinguished all scientific research. Geography, which shared the fate of the other sciences, was, however, revived sooner than the rest, and the circumstance which led to this was the travels of the Venetian, Marco Polo, in the fourteenth century. These travels were full of curious details, but they gave rise to very erroneous notions concerning the position and longitudes of places in Asia. After the discovery of America by Columbus at the end of the fifteenth century, geographers were employed in discovering the extensive coasts of that continent, and the countries and islands lying along it, and in inserting these new discoveries in their maps, according to such determinations of positions as they could obtain. Within thirty years of the date of the first voyage of Columbus, the whole coast of America, from Greenland to Cape Horn, had been explored, the Pacific Ocean had been navigated, the world circumnavigated by Magellan, the coasts of Eastern Africa, Arabia, Persia, and India had been visited by the Portuguese, and numerous islands in the Indian Ocean discovered. The expeditions of Frobisher and Willoughby in 1553 and 1576, of Hudson in 1607, and Baffin in 1616, greatly enlarged the knowledge of the Arctic regions. The spread of knowledge gave birth to the labours of the historical geographers of the seventeenth century, such as Chardin, Shaw, Pococke, and Chandler—men who combined a knowledge of antiquity and history with the requisite qualities of travellers. These travels greatly contributed to the improvement of geography as a science, though it was still in a very imperfect state. It had never been a subject of investigation, how far the physical character of a country was favourable or adverse to the civilization of its inhabitants. This has now in a great degree been effected by the naturalists and other men of science who, during the last and the present century, have visited nearly every part of the globe. In the seventeenth century the Dutch travellers, Tasman and Van Diemen, discovered the Australasian islands, and in the next century Captain Cook explored New Zealand and many of the Polynesian islands. The attention of travellers has in recent years been given to, and great progress has been made in, exploring the interior of the great continents, especially those of Africa and Australia. We may mention among the explorers of the former the names of Bruce, Park, Lander, Burton, Speke, Livingstone, Baker, Cameron, and Stanley; of the latter, Sturt, Eyre, the brothers Gregory, Burke, Wills, and M'Douall Stuart. By their labours our knowledge of the various countries explored is rendered precise and certain, and all the natural sciences rendered more complete and useful. The ambition of many explorers of the nineteenth century has been excited to attempts to pierce the mystery of the frozen oceans in Arctic and Antarctic regions, and though numerous discoveries have been made, there still remains a wide field for enterprise in that direction.

The importance which geography as a science has attained led to the formation of geographical societies. The first was established at Paris in 1821, and the second at London in 1830, called the Royal Geographical Society. This society publishes annually a volume of ***Transactions***, containing the narratives voluntarily contributed by distinguished travellers, analyses of new geographical works, and the records of expeditions sent out by the society. Numerous other geographical societies have been formed both in this country and abroad, which, aided by the encouragement afforded by the governments of different countries to plans of exploration, have given a great impetus to modern discovery, rapidly diffused the information collected by travellers relating to the most distant regions, and dispelled the fallacies which had hitherto obscured the science.

GEOLOGY. A. INTRODUCTORY.—1. *Definition.*—Geology (from the Gr. *gē*, the earth; and *logos*, a discourse) may be defined as the history of the earth in past times, and of those changes in the organic and inorganic worlds by which it has become what it is. Physical geography tells us of the present features of the surface of the earth, of the distribution of land and water, of the variations in climate, and of the present range of plants and animals. These two sciences are closely allied, since the one deals with the past and the other with the present history of the earth; and they may conveniently be grouped together under the head of *Physiography*, or the science which includes the history of the present surface of our planet and of those changes by which it has arrived at its present state.

2. *The Geological Method.*—The ancient history of the earth is based upon a strict induction, in which it is assumed that like causes have always produced like effects. A conglomerate, for example, is recognized as a petrified shingle-bank, because its rounded pebbles are identical with those on the margin of the sea or in the bed of the river; and the sandstones and clays are known to have been deposited as sandbanks and mudbanks, because their constituent particles are the same as those of sand and mud. The limestones, too, are proved to have been accumulated by the plants and animals living under water, and for the most part in the sea, because they are built up of fragments of shells, corals, and the like, similar to those of the creatures now inhabiting the margins and depths of the sea, or building up coral reefs within the tropics. The remains of fossil marine creatures found *in situ* upon the land imply that the sea once occupied the area in which they occur, and when they are found at various heights—at 8000 feet in the Pyrenees, 10,000 in the Alps, 13,000 in the Andes, and 18,000 in the Himalayas—it follows that there have been corresponding changes in the relation of sea and land in these regions. Thus we realize that large tracts of dry land have been formed beneath the sea, and that the present geographical conditions are the result of a long series of changes reaching back to a remote geological past. The fossils, too, in the rocks (the term includes soil, clay, and sand, as well as what is more generally understood by it) prove that there have been changes in the organic world as great as those in geography, and lay before us a wondrous procession of ancient forms of life, the rear of which is taken by those now on the earth. It is the province of the geologist to record the geographical changes, and to restore the face of nature as far as may be in the successive geological periods by means of an appeal to living plants and animals. In like manner, too, the study of the products of modern volcanoes offers the clue to the history of the igneous rocks, and the interlacing crystals in the lava enable us to understand the conditions under which the largely crystalline granites have slowly cooled from a molten state. From the examination of the effect of heat in the fusion of particles in an overburnt brick or in chalk melted under pressure, and the rearrangement of their constituents in the crystalline state,

the geologist is led to discover the changes by which rocks originally fragmentary have been converted into more or less crystalline gneisses, mica-schists, statuary marbles, and the like. For the accumulation of enormous thicknesses of rock a long lapse of ages is necessary, as well as for those changes in the organic world which allow us to use the fossils as the figures on the dial of a clock. It is necessary because accumulations of sediment are now formed very slowly, and organic change without the intervention of man is so slow as to defy observation. If, then, the infinitude of space has been revealed to us by the astronomer, so has the enormous duration of time past been demonstrated by the geologist.

3. *The Three Schools of Geological Thought.*—By the application of principles such as these the ancient history of the earth has been interpreted by an appeal to existing forces without any interference of a miraculous power with the operation of known laws. Have these forces varied in intensity? Are the enormous revolutions which the geologist recognizes in the rocks to be measured by the almost imperceptible rate of change observed in existing nature? Or have we, as Professor Huxley happily puts it, "an unlimited bank of force" to draw upon as well as "an unlimited bank of time?" The consideration of these points leads us to the examination of the three schools of geological thought—the Catastrophic, the Uniformitarian, and the Evolutionary.

The first of these ascribes geological phenomena "to the operation of forces different in their nature, or immeasurably different in their power, from those that we see in action in the universe." The doctrine of the violent upheaval of mountains, of the sudden depression of continents, of universal cataclysms, and the like, is catastrophic. The Mosaic, the Hindu, and the Egyptian cosmogonies may also be quoted as examples, as well as that of the Stoics. This method of accounting for geological phenomena was almost universal in the sixteenth, seventeenth, and eighteenth centuries, and among the most eminent of its exponents in modern times may be reckoned Humboldt, Cuvier, Elie de Beaumont, Sedgwick, and Murchison.

The second, or the Uniformitarian, is the doctrine of Hutton and of Lyell, by which all phenomena in the past history of the earth are ascribed to forces identical with, and not more energetic than, those now active on the face of the earth. From this point of view the forces which are now operating so slowly as almost to escape observation are adequate to produce the most stupendous geological results in unlimited time. Things have remained during the remote past very much as they have been during the last 3000 or 4000 years, and the equilibrium of nature has not been destroyed although local changes have taken place. According to Hutton "there is no evidence of a beginning—no prospect of an end." According to Lyell, "to assume that the evidence of the beginning or end of so vast a scheme (as that of nature) lies within the scope of our philosophical inquiries, or even of our speculations, appears to be inconsistent with a just estimate of the relations which subsist between the finite powers of man and the attributes of an infinite and eternal Being." There can be no doubt that this doctrine has been mainly instrumental in raising geology to the rank of a science, and that the law of rigid induction which it inculcates has led to most important results. Our experience, however, of the last few thousand years is far too small to allow of a sweeping generalization as to what has been during the immeasurable past. We have no right to assume from the present equilibrium of nature that the forces in operation in the past were not more intense in their operation than they are now.

The third doctrine is that of Evolution, founded by Kant, and which ranks among its followers such men as Tyndall, Spencer, Thomson, Darwin, and Huxley. Kant applies his views to the earth by an appeal to the gradual changes now taking place by earthquakes, by marine and fresh-water action, by the winds and frosts, and by the operations of man—anticipating the method of Hutton so far as the knowledge of his day would allow. "Kant," writes Huxley, "pictures to himself the universe as once an infinite expansion of formless and diffused matter. At one point of this he supposes a single centre of attraction set up, and by strict deductions from admitted dynamical principles shows how this must result in the development of a prodigious central body surrounded by systems of solar and planetary worlds in all stages of development. In vivid language he depicts the great world-maelstrom widening the margins of its prodigious eddy in the slow progress of millions of ages, gradually reclaiming more and more of the molecular waste, and converting chaos into cosmos. But what is gained at the margin is lost in the centre; the attractions of the central systems bring their constituents together, which then by the heat evolved are converted once more into molecular chaos. Thus the worlds that are, lie between the ruins of the worlds that have been and the chaotic materials of the worlds that shall be; and in spite of all waste and destruction Cosmos is extending his borders at the expense of Chaos."

The evolutionist fully recognizes, on the one hand, the uniformitarian doctrine of the operation of known causes in time past practically unlimited, and on the other the greater intensity of forces in past time insisted upon by the catastrophists, rejecting the arbitrary limitations of the one, and the equally arbitrary assumptions of the other. Evolution is the only hypothesis which will explain all the facts with which the geologist has to deal in his study of the earth.

The study of the earth falls naturally into four great divisions:—*Structural and Dynamical Geology*, relating to structure and to those forces by which structure has been produced; *Stratigraphical Geology*, relating to the classification and distribution of the rocks on the present surface; *Palæontology*, or the history of life on the earth during the successive periods; and *Applied Geology*, or its practical application to engineering, mining, and other arts.

B. Structural and Dynamical Geology.—The earth is a flattened spheroid, with a polar diameter of 7899·5 and an equatorial of 7926·648 miles, its mass being kept together by gravitation, and its equatorial bulging being caused by centrifugal force. The equator also is not a true circle, but an ellipse, with one diameter 2 miles longer than the other. The crust of the earth, or that part which is open to our direct observation, is a mere film covering the great mass of the globe, the structure and history of which as a whole can only be ascertained by an examination of its temperature and density, and by its comparison with the heavenly bodies, its fellow-wanderers in space.

1. *The Temperature and Density of the Earth.*—The existence of volcanoes and hot springs testifies to the heated condition of the areas from which the heated substances come, and the increase of temperature universally observed in descending into deep mines proves that it is not local, but that there is a steady flow of heat towards the surface. In some mines the rise is one degree per 40 feet, and in others one degree per 70 feet. According to Lyell the increase of one degree per every 65 feet of descent would be sufficient to boil water at a depth of 2, and to melt iron at a depth of 34 miles. Below this the heat would be sufficient to fuse all known substances under ordinary atmospheric pressure. It does not, however, follow that the solid crust of the earth is floating on a zone of fluid matter, because of the enormous pressure of the rocks. It has been proved experimentally that the melting-point of some substances, such as iron, is raised

under pressure. The pressure of 30 or 40 miles of rock must be very great, and unless we know the relation of the heat to the pressure we cannot be sure of the existence of a fluid zone. If the pressure preponderate, as Scrope conjectures, the earth may be solid to the very centre, and if the pressure be relieved at any one point deep below the surface the heated matter may at once become fluid. It follows, therefore, that the outpouring of lava from volcanoes throws no light upon the thickness of the solid portion of the earth. According to Hopkins the phenomena of precession and nutation imply that the earth is solid to a depth of from 800 to 1000 miles; while Thomson, arguing from the same premises, concludes that the earth as a whole must be far more rigid than glass or steel, and that the interior must be many times more rigid than the upper crust. The amount of heat lost by the earth is estimated by Mallet at an amount sufficient to melt 777 cubic miles of ice per annum, and this is derived from the interior partly by conduction through the upper strata, and partly by convection by means of volcanoes and hot springs. Nor is there any source from which this heat can be restored to the earth, which is universally regarded by the physicists as a cooling body, passing from an intensely heated towards a cold state. It will therefore follow that in the past the earth was hotter than it is now, and in the remote geological past very much hotter; and it will further follow that when there was more energy in the earth the reaction of the enormously heated interior on the surface was far greater, and made itself felt by swifter changes of the surface than at the present day. From this line of inquiry we may conclude that there was a time when the earth was molten at the surface, and surrounded by a fiery atmosphere of elements vaporizable at high temperatures.

The conclusion that the earth was formerly more intensely heated than it is now is strongly confirmed by the evidence offered by its specific gravity as compared with that of the rocks and minerals which appear at the surface.

The specific gravity of the earth, . . .	5·5
Rocks forming crust, ...	2·5
Silicious or acid rocks, ...	2·65
Basic rocks, ...	2·95
Forged iron, ...	7·78
Cast gold, ...	19·258
Platina, ...	22·69
Iridium, ...	23·00

The high specific gravity of the earth as a whole, more than twice as high as the average of the rocks composing its crust, can only be explained by the presence of the heavy metals, and probably also of the heavy bases in its interior; and it may be concluded, with Daubrée, Durocher, and Haughton, that beneath the crust the materials are arranged according to their specific gravities. They could not, however, have been so arranged unless they had been sufficiently heated to allow of free motion among their constituent atoms. Thus from the consideration of the specific gravity of the earth we obtain testimony tending in the same direction as that based on its present temperature as to its former intensely heated state. This arrangement, however, has been profoundly affected by the circulation of water, by which some of the heavy elements—iron, for example—have been widely distributed, as well as by various chemical reactions, by which they have been rendered soluble and transportable to points within our reach.

2. *Relation of the Earth to the Heavenly Bodies.*—The comparison of the earth with its fellow-wanderers in space carries the argument as to its original condition a stage further. The sun, stars, planets, the moon, the meteorites, and the nebulæ are linked to the earth by the bond of an identity of elements. In the great centre of our system the photosphere, or zone of solid heated particles, is surrounded by a solar atmosphere of cooler gases, in which the elements are arranged according to their specific gravities. Hydrogen is the highest; then comes magnesium, calcium, and sodium; and below these iron, nickel, manganese, chromium, cobalt, barium, copper, zinc, titanium, aluminium. With one exception all the solar elements are identical with those found in the earth, and the principal physical differences between the sun and the earth are mainly that the former is larger and hotter than the latter. The stars, too, are revealed by the same delicate test of spectrum analysis to be suns composed of the same elements as the earth. In Aldebaran, according to Huggins, are hydrogen, sodium, magnesium, calcium, iron, antimony, mercury, bismuth, and tellurium; in Sirius, sodium, magnesium, and hydrogen.

The planets are bodies in various stages of cooling. In Mars, the only planet whose true surface can be studied, the conditions of life are similar to those on the earth. The researches of Professor Phillips and others prove that its surface is occupied by sea and land, and is subject to the same climatal laws as our own planet. As the winter comes on the snows gradually extend towards the equator, until they cover an area round the poles as far as the 45th parallel of latitude with a shining mantle of white. When the spring comes they retreat again, until at midsummer they form an arctic barrier reaching 10° round the poles. Mars therefore has polar, temperate, and equatorial regions like our own, and so far as relates to summer and winter, heat and cold, and atmospheric conditions generally, it is as well fitted for the maintenance of life as the earth. Its outer crust, too, may be inferred to be largely composed of aqueous strata, the product of the erosion of the land by seas, lakes, and rivers; and its interior is undoubtedly in a heated condition, since, were it not for an internal store of energy similar to that on the earth, the cold on its surface would be too intense to allow of the observed changes of climate so strictly analogous to our own. The rest of the planets have their true surface concealed by an envelope of cloud, the existence of which implies an internal heated condition. They have also been shown by Secchi and Jansen to possess atmospheres charged with aqueous vapour.

The moon and the meteorites present us with extra-terrestrial bodies in a state of extreme cold.

The moon, without an atmosphere, lifeless and cold to its very centre, presents the most stupendous volcanic cones and rifts on the surface next to the earth, which show that in the past she possessed a store of internal energy which has been lost, as well as elastic gases and imprisoned water in her interior, of which now there is no trace. From the identity of the results of lunar with terrestrial volcanic activity, it may also be inferred that the igneous rocks in the moon are the same as those in the earth.

The meteorites, intensely cold in space, only become incandescent when they strike into the earth's atmosphere. They are composed of the same elements as those of our earth, some twenty-seven in number, variously combined, and characterized by the extreme rarity of oxygen—some being masses of nickeliferous iron, others of nickeliferous iron with stony grains, and others of various substances without iron. Their crystalline structure is evidently due to their original molten condition. Those containing olivine and alumina are taken by Meunier to be the equivalents of the heavy basic rocks, and those formed of nickeliferous iron are considered by Thomson and Haughton to illustrate the unoxidized interior of the earth—composed of heavy metals. This latter conclusion is strengthened by the fact that the heavy metals are accidental in their occurrence both in the stratified and crystalline rocks in the earth, and can be traced home to neither, from which it follows that the original home must be in the interior of the earth.

We may conclude from all these facts that matter is the same in kind throughout the universe, but at various

temperatures—fiery in the comets, nebulæ, sun, and stars; cooling in the planets; and cold in the moon and the meteorites. The earth is now slowly cooling down, as it swings in spirals towards the sun. It passed probably from the condition of a nebula into a fiery sun-like stage, from that into its present habitable condition, and is inevitably tending towards the cold and lifeless state of the moon and of the meteorites. It will ultimately be swallowed up by the sun. As the sun stage of its life drew to a close, but while it still remained molten at the surface, its atmosphere, according to David Forbes, was probably composed (1) of a zone of steam and dense vapours of compounds volatile at high temperature, in which salt (chloride of sodium) would abound; (2) of a zone of carbonic acid gas; (3) of oxygen and nitrogen. As the cooling went on the chloride of sodium vapour would condense into a layer of salt 10 feet thick over the whole globe. The steam, too, would condense, and water collect in the inequalities of the surface and form oceans, salt from the very beginning. Then first arose the great contest on the surface of the earth which has continued every since, between fire and water, fire or earth-heat building up the land and lifting it up above the dash of the waves; water, as rain, rivers, sea, frost, and snow, ever striving to reduce it to one uniform dead level near low-water mark. Out of this contest have sprung all the diversity of earth-sculpture, and the varying relations of sea and land.

3. *The Constitution of the Earth's Crust.*—The earth's crust, or that portion of the earth which is open to our observation, is composed of rocks which are divisible into three well-defined groups:—(1) The *Crystalline*, or those built up of crystals which are the result of cooling from a state of igneous or aqueo-igneous fusion, such as lava and granite. In this the glassy rocks, such as obsidian, are included. These are unstratified, *i.e.* not found in layers, and are without fossils. (2) The *Fragmental*, or those which have been built up of fragments turn by the sea, rain, rivers, frost, snow, and wind from pre-existing rocks, such as conglomerate, sandstone, clay, or accumulated within the tissues of plants and animals, such as coal and limestone. To this division also belong the volcanic agglomerates, or angular materials piled round volcanoes, and volcanic ashes and dust. These rocks are for the most part deposited by water, and are stratified and fossiliferous. (3) The *Fragmento-crystalline*, or those rocks originally composed of fragments which have assumed more or less the crystalline state by the combined action of heat and water, such as mica-schist and statuary marble. They are also termed aqueo-igneous or metamorphic, and are unfossiliferous in proportion to the amount of change undergone.

4. *The Igneous Crystalline Rocks.*—The products of modern volcanoes vary in mineral character from the glassy obsidian and lava, in which the crystalline structure is represented by little needle-shaped crystals (Plate I. figs. 1, 2), to the coarsely crystalline structure which is to be seen in some of the more stony lavas (fig. 3). This difference is due to the varying rate of cooling and to the amount of pressure. If the cooling has been swift the crystals will be small, if it be slow they will be proportionally large. A gradual passage may be traced from the glassy rock at the surface to the largely crystalline rocks which have been formed at great depth below (*i.e.* Plutonic), such as granite (fig. 4), composed of quartz, felspar, and mica, in which the glass-cavities in the component crystals testify to th heat, and the water-cavities to the presence of water. The igneous crystalline rocks are divided into two well-defined groups by their chemical composition and their densities.

(1) The *acid group*, characterized by the high percentage of silica, and their poverty in iron, lime, magnesia, and soda, and by their specific gravity ranging from 2·4 to 2·7. To it belong obsidian (Plate I. fig. 1), pitchstone (fig. 2), trachyte, pumice, granite (fig. 4).

(2) The *basic group*, characterized by the poverty in silica and richness in the "bases" lime, magnesia, soda, and in iron, and having a specific gravity ranging from 2·8 to 3·2. It includes the lavas, basalts (fig. 3), greenstones, diorites, dolerites, &c. This difference between the two groups of rocks is accounted for by Durocher and others, on the hypothesis that they consolidated from two distinct magmas as incapable of mingling as water with oil. The lighter or uppermost was the first to consolidate in the cooling globe, and hence the abundance of the acid rocks, and more especially granite in association with the oldest rocks (Archaian), and their rarity in existing volcanoes; while the heavier, or the basic, found its way to the surface through the fissures formed in the cooling granite at a later time, and is now predominant among volcanic products. The acid rocks occur in Britain (see Map), mainly in the western parts and in the Highlands of Scotland, while the basic are found also to traverse the Primary strata in Scotland, Durham, and Northumberland, and in Middle England. In the Tertiary period the island of Mull was the base of an enormous Miocene volcano, and the district of Antrim was overwhelmed by a vast sheet of lava in Miocene times.

5. *The Fragmental Rocks* (see Map).—The fragmental rocks consist of (1) the *arenaceous*, or those of the sea-shore (Lat. *arena*); (2) the *argillaceous*, or the clays (Lat. *argilla*); (3) the *organic*, or those composed of the fragments of plants and animals; and (4) the *breccias*, or those composed of angular fragments imbedded in a natural cement.

(1) The *arenaceous* rocks are the shingle-banks, gravels, and sandbanks of marine and fresh-water origin. These compacted together form conglomerates or pudding-stones and sandstones, in the latter of which silica is so abundant that this division is termed *silicious* by Lyell. The sandstone, if the component grains are large, is termed a *grit*; and if mica, carbonate of lime, or other striking adventitious element be present, *micaceous*, *calcareous*, &c. The pebbles in the conglomerates are generally cemented together either by carbonate of lime and magnesia or by silica, and sometimes by peroxide of iron.

(2) The *argillaceous* rocks are composed of the more finely divided mud in which silicate of alumina is present. To this is due the peculiar earthy smell when clay is breathed upon. *Kaolin*, or the porcelain clay of China, consists of 71·15 parts of silica, 15·86 of alumina, 1·92 of lime, and 6·73 of water. When the clays have been subjected to the pressure of the rocks above, parallel to the planes of deposition, they become laminated, and are termed *shales*. If, however, the pressure has been applied to clays in directions bearing no relation to the stratification, in such a manner as to flatten out the rounded particles, or to cause the particles to be rearranged with the long axes parallel, and thus to produce slaty cleavage, they are termed *slates* (figs. 5, 6).

(3) The *organic* rocks are—calcareous, silicious, or hydrocarbonic. The *calcareous* or limestone series is composed of carbonate of lime secreted by the Mollusca, Coral-zoophytes, the Echinodermata, the Foraminifera, Sponges, and the Nullipores, and generally compacted together by subsequent infiltration. This is illustrated by the sections of the chalk (fig. 7), in which the Globigerina, a foraminifer found in all the deep seas, is seen surrounded by fragments of other organisms and imbedded in hardened calcareous mud. Sometimes the rock is formed of little rounded spheres like the roe of fishes (fig. 8), and is termed *oolitic* (Gr. *oon*, roe). This structure is developed only in coral reefs, and is formed of successive layers of carbonate of lime deposited round a centre formed of a fragment of shell or coral, &c., which happened to lie on the shore between tides.

The magnesian limestones (fig. 9) and the gypseous rocks are also classed with the calcareous division.

The silicious skeletons of the diatoms in the vegetable kingdom, of the Polycistineæ in the animal kingdom, abundant in sea water, and more particularly in some areas in the deep seas, and of Sponges, are the principal sources of the silicious organic rocks. The two former constitute the polishing powder of Tripoli and the diatomical earth or "mountain meal," and the latter has also contributed largely to the formation of flint in the Chalk, and the chert in the Limestone.

The peat-bogs, lignites, coals, and anthracites form the group characterized by *hydro carbons*, and are mainly the results of vegetation. The peat-bogs are accumulated mainly by the action of mosses, among which sphagnum is dominant; the lignites, by the partial alteration of buried forests. The coal is an accumulation upon the ancient surface of the land of a dense growth of vegetation, in which gigantic club mosses were dominant, and from it the steam coal forms an easy transition to the anthracite, and that again leads towards plumbago or graphite and to the diamond, both forms of pure carbon.

The resinous element in the blazing coals is due to the resin secreted by the spores of the club-mosses and ferns, as well as to that in the cells of the various conifers in the Carboniferous forests (fig. 10).

(4) The *breccias* are formed by the weathering of angular fragments off the surface of cliffs and steep slopes, accumulated at the bottom in the form of a *talus*, or of angular and subangular ejecta thrown out on the flanks of a volcano. Sometimes, as in the flanks of the Mendip Hills in Somerset, the breccia passes insensibly into a conglomerate.

6. *The Action of Water, Frost, Ice, and Snow, Wind, and Carbonic Acid on the Surface of the Earth.*—The agents by which the solid rocks are reduced to fragments must now be considered, and first of all the sea. Three-quarters of the surface of the globe are occupied by water, and on every shore the process of destruction is going on. Each wave acts as a waterfall, and operates not only with the water-pressure, estimated in a heavy gale on the west coast of Scotland by Stephens at 6083 lbs. per square foot, but by the stones which it hurls against the cliff and grinds into shingle, sand, and ultimately into mud. Its cutting action varies according to the hardness of the rock and the force of the currents, sometimes being very slow, as in the case of St. Michael's Mount, which has not been appreciably affected since the days of Diodorus Siculus (B.C. 9), and sometimes very swift, as on the coasts of Norfolk and Suffolk, and the Isle of Sheppey, and is confined to a short distance above high-water and below low-water marks. The waves also carry on the work of destruction, when the rock is fissured and cavernous, by forcing air into the crevices out of the reach of their direct action, and thus wedging down masses of rock. According to Darwin but little erosion is going on at a greater depth than 40 to 60 feet in the Pacific, and but little, according to Godwin Austen, in the British Channel at the depth of 40 to 60 fathoms. In the Straits of Dover, in the line of the projected channel tunnel, the chalk bottom down to 35 fathoms is bare, and a slight erosion is probably going on. As the margin of the land is eaten away by the waves, a plateau is formed sloping gently from low-water mark, over the area where the land formerly stood. These plateaus of erosion form a narrow shelf round our shores, and are sometimes depressed beneath the limits of marine attack, as in that which extends down to the hundred-fathom line, forming a kind of pedestal for the British Isles. They are also frequently to be seen high above the sea, forming a noteworthy feature in the landscape, as in the Pennine chain of hills at 1200 feet, and at Moel Tryfaen, in the district of Snowdon, at 1392. They also occur in the mass of the rocks, as in fig. 13, in which, along the line *a a*, an ancient line of cliffs has disappeared, and the resultant plateau has been buried beneath marine accumulations of a later period—the Carboniferous. The destruction of the cliffs by the breakers must have been very slow, and the depression in this case of the area to the depths of the sea implies a considerable change in geography. The accumulation of rocks above many hundred feet in thickness also must have occupied a long time. For the Lower Silurian rocks also to have been deposited in the sea, and to have been lifted up to form the land, must have needed long ages. Such a buried surface of marine erosion constitutes a "geological break," which always defines the close of one great life-period and the beginning of another, as for example between the Primary and Secondary groups, between the Permian and Triassic rocks (fig. 23), and at the close of the Secondary, between the Chalk and the lower Tertiaries (see Map).

The fragments torn from the land are distributed in the sea according to the resistance of the surfaces, and not according to the weights—the shingle and sand near to the coast-line, the finer sediments further away from the shore. Still further out to sea an exceedingly slow calcareous deposit is going on, formed by various organisms, extending down to a depth of some 2000 fathoms, below which comes the red clay, resulting from the disintegration of water-logged volcanic and kosmic dust. These deposits are lenticular, and are being formed simultaneously. Viewed over wide areas they may be said to be approximately horizontal, and to constitute "plateaus of deposition," or in other words "strata."

The action of the sea in destroying the earth is analogous to that of a carpenter's plane on a piece of wood: the rain, torrents, and rivers act like chisels vertically. If a heavy shower falls on a sloping bank formed of sand and pebbles it will cut a series of pyramids, each protected at the apex by a pebble. These pyramids are seen on an enormous scale in the Sevalik Hills in India, and on a smaller scale at Botzen in the Tyrol, and in the district of Issoire in Auvergne. The torrents cut deep V-shaped ravines for themselves, the bottoms of which are always being ground away, while the sides are gravitating within reach of the water, and they are ever cutting their way back to the water-shed. As the slope becomes more gentle they pass insensibly into the river, by which the work of destruction is carried on; and the fragments, rough-hewn by the torrent, are ground finer and carried away to lower levels and ultimately delivered into the sea, where they form deltas. When the rocks are horizontal and compact the torrents and the rivers hollow out gorges sometimes as in the case of the cañons of the Colorado, 6000 feet in depth, the water occupying the great portion of the bottom. In the case of ordinary river-valleys, however, the river has never occupied the whole of the valley at the same time, but has visited in turn every part of it, shifting its course horizontally and at the same time deepening its bed, and leaving behind patches of loam, sand, and gravel at various heights above its present course, the highest being the oldest. The fiords of Norway, the lochs of Scotland, and inlets such as Sydney Harbour in Australia, are merely submerged ravines, which sometimes have been widened and deepened by glaciers. While, however, the rain, torrents, and rivers act upon the land like so many chisels, cutting gorges and valleys, the frost, ice, and snow act like a piece of sand-paper, rounding off the angles and producing a rounded contour. The frost attacks the rocks directly by driving home the ice-wedges into the crevices, and does its greatest amount of work on the rocks most exposed to loss of heat by radiation. Consequently the upper parts of the V in a ravine are more quickly reduced to ruin than the lower, the vertical wall of a precipice becomes oblique, and the tops of mountains are converted into a wilderness of tumbled blocks. Snow also does its work mainly by slides and avalanches on steep slopes, and accumulates vast quantities

of debris in the higher valleys; and ground-ice, forming at the bottom of rivers, deepens them by floating up blocks of stone, gravel, and sand, and carrying them away. The glaciers, or great ice-rivers fed by the snow-fields, 8500 feet above the sea in the Alps, and 9000 in the Pyrenees, grind and score the rocks through which they flow, principally by the blocks of stone which are imbedded in the moving ice. Owing to this rasping action the glacier bed is hollowed, so that the original **V** of the torrent before the glacier occupied the ravine has been converted into a **U**, and all opposing rocks are rounded. The traces of glaciers are widely distributed through the northern hemisphere, and at lower levels and in lower latitudes than the present glaciers. In Britain the rounded contours of the hills of Wales, the Pennine chain, and the Lakes, and of Scotland, are due to the work of confluent glaciers, which have passed over hill and dale. Sometimes the glaciers have ground hollows in their beds, giving rise to pools and lakes, such as Windermere, &c., after their retreat. Sometimes the pools and lakes are formed by banks of glacier-borne debris. The coarser materials entangled in the glacier are deposited when the ice melts as a "moraine," or tumbled masses of gravel, stones, and sand, but the finer sediments are carried far away down to lower levels by the glacier stream, and are ultimately deposited as sheets of clay and loam, such as those of the Rhone and the Rhine. When, however, the glacier flows, as in the case of Greenland, into the sea, large fragments of it break off and are floated by the currents away, and as they melt, the scratched stones, sand, and fine mud drop to the bottom and constitute boulder clay.

Among the agents in scenery-making the wind must not be omitted, by which "sand dunes" are formed, and the hardest rocks grooved, cut, and polished by the grains of sand swept over them. Still less must carbonic acid be ignored, ever present in the atmosphere, and given off by animals and plants. It attacks equally the igneous, crystalline, and the calcareous fragmental rocks, decomposing the former, and carrying the latter away in solution, and thus forming the subterranean water-channels in limestones or caves; and these, losing their tops, gradually become ravines, such as Millersdale in Derbyshire, and Cheddar Cliffs in Somerset. The mechanical action of running water has also its share in producing these results.

By the operation of the above-mentioned agents during vast periods in past time the principal features of the landscape are formed. The mountains and hills, the volcanic excepted, are merely portions of the earth's crust left standing in relief, while the valleys and ravines are the work of the torrents and rivers, smoothed and rounded in glaciated regions by the ice. The horizontal or gently inclined surfaces are plateaus. The amount of rock removed by these agents is enormous—no less than 11,000 feet near Buxton (Plate IV. fig. 22), and 31,680 feet in the district to the east of Snowdon; and the materials torn away are to be found worked over again into fragmental rocks of later age.

7. *The Fragmento-crystalline Rocks.*—The fragmental rocks, which have been subjected to great heat and pressure in presence of water, when sunk deep beneath the surface, are always changed, and assume a structure more or less crystalline, and sometimes lose their fragmental character altogether. In some cases, according to A. Geikie, granite is the purely crystalline result of this alteration. Generally, however, the fragmental origin of the rock has left some traces behind. In the case of the silicious inorganic rocks the grains of sand are sometimes cemented together or form the centres of crystals of quartz, with but little trace of their original rounded shapes. In the argillaceous or clay rocks every change is to be seen, from the claystones into slate, argillites, and jasper, and into various schists, in which a foliated structure is developed, by which the constituent elements are arranged in thin folia or plates parallel to the lines of original deposition, as in mica-schist (Plate I. fig. 11), composed of mica and quartz; gneiss, of mica, quartz, and felspar; chlorite-schist, talc-schist, &c. In all these the elements in the original fragmental rocks have been combined into various minerals, which are for the most part crystalline. All the schists bear unmistakable marks of great lateral pressure, applied while they were in a plastic state and deep beneath the surface, in their contorted structure, by which they have been thrown into folds great and small, and compelled to occupy a much smaller horizontal extent than they originally occupied (figs. 11, 18).

The organic division presents changes analogous to the above. The calcareous rocks gradually lose their fragmental character, until they reach the crystalline state, without traces of fossils or stratification, as in the statuary marble (Plate I. fig. 12). The hydro-carbonic rocks pass from the condition of lignite and coal into anthracite and graphite, and the development of diamonds represents the last link in the series of changes.

8. *Movements in the Crust of the Earth caused by Earth-heat.*—The land, as we have seen, exposed to the ceaseless attacks of the various forces operating from above, by which it is torn away piecemeal and ultimately deposited in layers of fragments below the surface of water, would in the long geological past have been reduced to one dead level below low-water mark, were it not for the heat-force which operates from below and keeps it above the waters. The position of the marine fragmental rocks above the sea is proof that such elevation has taken place on an enormous scale. The buried land-surfaces, also, covered with vegetable matter grown on the spot, such as the coal-seams and the submerged forests, show that large portions of the earth's surface have from time to time been depressed beneath the sea. The submerged hills, valleys, and ravines, and the coral islands or "atols" which are the monuments of submerged continents, point also to the same conclusion. Were it not, too, for these movements the fragmental strata would be approximately horizontal, instead of being, as they generally are, inclined, and in some cases turned up at right angles as in the Isle of Wight, or inverted as in the Belgian coal-field. Earthquakes, or vibrations in the crust of the earth, starting from one or more centres at various depths, are the result of jars produced directly or indirectly by earth-heat. Permanent changes of level have been observed to have taken place during earthquakes. Thus in 1822 Chili was lifted up 3 feet near the coast, and from 6 to 8 feet further inland over an area of 100,000 square miles. In 1835 it was observed to have been raised from 4 to 5 feet by Fitzroy and Darwin, and the island of Santa Maria 10 feet, and two years later the sea-bed was raised 8 feet. It is obvious, then, that the Pacific shore of South America is rising in the present century by a series of jumps during earthquakes.

These sudden changes of level are, however, comparatively unimportant when compared with those slowly brought about by the direct action of the heat within the earth in vast periods of past time. Scandinavia, as Lyell ("Principles" ii. 31) has shown, is gradually rising in the northern part and sinking in the southern. At Gefle, 90 miles north of Stockholm, the rise may amount to as much as 2 or 3 feet in a century, while at Stockholm it is from 3 to 6 inches. Still further to the south, in Scania, the movement is proved to be in the opposite direction by the submerged beds of peat, and the position of some of the streets in the seaport towns in Scania below high-water mark. In a high wind at Malmö the sea flows over one of the present streets, and at a level 8 feet lower is an ancient street which could not have existed had the site of Malmö always been at its present level. The rise of the ground 100 miles to the west of Stockholm, at Linde, is proved to have been 230 feet by the deposits with recent

dwarfed Baltic shells at that height above the sea. The western portion of Greenland also is now sinking, and the remains of old buildings are now to be seen beneath the sea level This depression has been traced 600 miles, from Disco Bay in the north to Iglalik Frith in the south.

These movements in the crust of the earth are directly or indirectly related to the present heated condition of the earth. If the rocks below are becoming hotter than they were before, the ground above will rise; if they are becoming cooler, it will sink. Using the experiments of Colonel Totten, by which it has been ascertained that fine-grained granite expanded at the rate of ·000004825 per degree Fahrenheit, and red sandstone at ·0000009532, Lyell shows that a mass of rock expanding at the rate of sandstone and a mile in thickness, raised to 200° Fahr., would lift up the surface to a height of 10 feet above its former level. As the temperature and thickness of rock affected by it increased. the elevation would be proportionally great. The cooling of the rock would cause a corresponding subsidence. The local character of these movements may be explained by the hypothesis of Mr. Mallet. The earth is at present losing heat, and as it cools it contracts. But the loss of this heat will cause a greater contraction of the more highly heated deeper portions than those which are above them and less heated. Consequently hollow spaces will be formed at various points deep beneath the surface, which will be filled in from time to time by the crushing down of the superiacumbent rock. At these points of crushing the movement of the rock will be converted into heat sufficient to raise the temperature of the surrounding area to an enormous extent. This hypothesis not only explains the local elevation and subsidence of land, but it also explains the origin of faults and the sporadic nature of volcanoes and earthquakes. The faults are the lines of fracture and movement in the rocks above, and the earthquakes are vibrations caused in the main by the rending of the rock, while the volcanoes are caused by the access of water to the heated rock in the focus of the volcanic disturbance. The contraction of the earth as a whole must throw the surface into a series of folds. Mr. Mallet estimates that the diameter of the earth has diminished by 189 miles since the time that it was molten at the surface. The salient folds would tend to rise above the sea-level, and the re-entering to sink beneath it. In this manner we may satisfactorily explain the main outlines of the distribution of the continents and of the oceans.

The same kind of compensatory movement observed in the Scandinavian Peninsula is to be noticed in the distribution of the continents and oceans in the surface of the earth, the former being proved by the marine fragmental rocks to be areas of elevation, and the latter, by the submerged land-surfaces forming the bottom, to be areas of depression. The general view that the oceanic areas have been areas of depression through all the geological past is open to considerable doubt. The submerged land contours prove that they occupy old land areas, now sunk to the depth at least of 500 fathoms in the North Atlantic, between Greenland and Scotland. The question of depth practically resolves itself into a question of time, and there is no more difficulty in accepting the conclusion that the depths of the ocean have been dry land, than that the fragmental rocks of lofty mountains have formerly been beneath the waters of the sea. At all events this is more probable than to suppose that all the movements of depression which have taken place have been confined to the margins of the ocean, while we know that the elevating movements have not been so confined.

The stratified rocks, owing to these movements, have been thrown out of their original position, which was approximately horizontal. Their angle of declination from the horizontal is termed the *dip*. This is obviously at right angles to the *strike*, or a line at which the rock would emerge on a horizontal surface not cut up into hill and valley, the *outcrop* being the line of its appearance, which is dependent upon the inclination of the strata and the contour of the ground.

Faults are lines of fracture and dislocation in the rocks produced by movements of elevation and depression, which divide the rock into a series of wedges (figs. 14, 15), those with their broad ends downwards having been thrust upwards by the expansion of the rock. The amount of vertical displacement (see fig. 15) is termed the *throw*, and the declination of the line of fault from the vertical is the *hade*. Faults vary in character according to the nature of the rock. If it be soft and homogeneous, they are mere planes of division; if it be hard and irregular, they are irregular and very wide.

The lateral pressure by which the fine particles in the slates have been flattened and re-arranged with their long axes parallel, so as to cause them to become fissile, is in part at least produced by the impact of the wedges upon one another (see fig. 15).

The rocks, and more particularly those which are the oldest, and therefore which have been sunk the deepest from the surface, have been thrown into curves by lateral pressure being brought to bear upon them either directly by the shrinkage of the earth's crust, or indirectly by the great wedges of rock with their surfaces bounded by faults. The salient curves are *anticlinals* or saddles (Plate II. fig. 16), and the re entering *synclinals* or troughs. Sometimes the strata have been inverted. Contorted rocks are those in which the laminæ, as for instance in gneiss and mica-schist (Plate I. fig. 11), have been thrown into a complicated series of small folds.

The influence which the folds have had in determining the position of mountain tops is very remarkable. Just as in bending a thick piece of cardboard the outer side tends to crack, and the particles on the inside to become compressed, so is it with the folded rocks. The upper parts of the rocks become loose-textured and easily removed by the elements in their anticlinal portions, and they are compacted together in the synclinals, and therefore the former as a rule occupy the valleys, and the latter form the tops of the hills. This is well illustrated in Plate II. fig. 16, in which the top of Snowdon is seen to be a synclinal, and the Ffestiniog valley to be an anticlinal, from which, according to Ramsay, no less than 21,120 feet of rock have been removed, represented by the dotted line in the figure. From these and the foregoing remarks the reader will gather that mountains do not owe their present shape to mere elevation. They have been lifted up from below by the earth-heat, and in the long course of ages have been left standing out in relief by the various agents which combine together to produce the general phenomena of denudation—water, frost, wind, and chemical action.

Among the phenomena produced in the fragmental, in the crystalline, and the fragmento-crystalline rocks by cooling and contraction, are the planes of division known as *joints*, which traverse them in every direction. In the first these are formed by contraction, probably during consolidation, and are generally at right angles to the stratification. These joints form lines, along which water percolates and then acts upon the rock, decomposing the crystalline rocks into a series of spheroids, and attacking the fragmental rocks in various ways and staining them with various salts, mainly of iron.

9. *Circulation of Water beneath the Surface: Caves and Mineral Veins.*—Some portion of the rain falling on the surface finds its way downwards through the fissures and faults to enormous depths, and as the heat increases with the depth a definite circulation is set up, as in a kettle of water heated from below, a cold current descending to take the place of the hot current which passes surfacewards. Each of these currents has a profound

influence in modifying the rocks and minerals with which they come into contact. The cold subaerial water carries down with it carbonic acid and oxygen, converting the insoluble carbonates into soluble bicarbonates, and oxidizing the substances which are liable to oxidization, enlarging the water-passages in some places, and filling them up with deposits in others. Owing to this action, combined with the mere mechanical action of the water, caves are formed in the calcareous rocks, such as those of Cheddar, the Peak, Ingleborough, Adelsberg, and Kentucky, the carbonate of lime being carried down the lower levels, and sometimes carried out into the streams in the "hard" water, thence into the rivers and into the sea, where it again assumes the solid shape in the shells of Mollusca, Foraminifera, Nullipores, and other animals and plants. These again form deposits at the bottom of the sea, which in the long course of ages are lifted up and become parts of the land; and then the process of destruction begins again. Thus there is not only a circulation of water above and below its surface, but also a never-ending circulation of carbonate of lime—from the hills to the sea, from the sea to the land. If water saturated with bicarbonate of lime be exposed to evaporation, or to free currents of air, the excess of carbonic acid, which acts as a float to the particle of carbonate of lime associated with it, is taken up, and the particles at once assume the crystalline form. In this manner are deposited the stalactites or the stony tassels and drapery covering the roof and walls of some caverns, and the crystalline marble-like stalagmites on the floor, as well as the columns formed by the gradual uniting of the descending stalactite with the stalagmitic pedestal on the floor caused by the splash of the drops from the roof. The tufa in the open air, and the deposit on the stones—pieces of stick, and the like—are due also to the same cause. These operations are going on at ordinary temperatures and at surface pressures. As, however, the water descends to great depths it becomes hotter and subjected to greater pressure—two conditions which add enormously to the power of its chemical action as well as to its power of traversing dense bodies. Thus water under ordinary conditions will only very slightly dissolve silica, while a wine glass put into a steam boiler has a considerable amount of its silica removed, and its structure is completely changed. Under high pressure water finds its way through the pores of steel. From these and other experiments it is certain that at great depths water would act most energetically on substances which are either insoluble or slightly soluble at the surface. The work therefore done by the currents of water at enormous depths must be very great in attacking the minerals and carrying them away in solution. If we turn our attention to the heated water laden with minerals, as it passes upwards towards the surface, it is obvious that as the temperatures and pressures diminish the minerals will be dropped in the water-passages, which may ultimately become completely blocked up by successive layers of minerals, which need not necessarily be of the same kind, and thus mineral veins be formed, and filled with materials brought from the deeper parts of the earth, and placed within the reach of man. In some cases the water arrives at the surface so swiftly that it has not had time to lose all its heat or its minerals, as in the case of the hot springs of Bath, Buxton, &c. Most hot springs, however, are not supplied from the deep-seated hot waters, but from the rain or the sea-water finding its way into the heated volcanic rock comparatively near the surface, as in the geysers of Iceland and the Yellowstone, or the waters of Royat and Vichy in Auvergne, or the hot springs in the neighbourhood of Naples. Thus there is a continual circulation of matter going on in the earth, and mineral changes are being produced wherever water can gain access; in other words, in all rocks, for we know of none which is completely devoid of all trace of water.

Mineral veins consist of one or more minerals deposited within a fault, fissure, or series of cavities in the earth's crust, and they vary in breadth from the thinnest film to a width of hundreds of feet. The *rake veins* of North Britain and the *lodes* of Cornwall extend indefinitely downwards, occupying lines of fissure and fault, and are therefore generally in right lines. Those running east and west, or nearly so, are *right-running*, and those north and south, or nearly so, are *cross courses*. *Pipe veins* are irregular tubular cavities in the rock filled with spars and ores, and they pass into the flattened cavities, generally coinciding with the stratification of the rock, which give rise to *flat veins*.

The minerals found in veins are spars, such as quartz, calcite, fluor, and barytes; ores or metals in chemical combination with other elements, such as oxides, sulphides, carbonates, and sulphates; or native metals, gold, platinum, palladium, tellurium, silver, copper, iron, lead, antimony, arsenic, and bismuth. These are generally arranged in bands parallel to the bounding surfaces (Plate II. fig. 17) or cheeks of the veins, with the points of the crystals pointing towards the inside, forming the "combs" of the Cornish miners. From this arrangement, and from the fact that the bands on one side of a vein, filled with dissimilar minerals, find their equivalents on the other, it is clear that they have been deposited by water traversing the fissure at successive times, those near the cheeks being the oldest, and those in the centre the newest. Sometimes after the fissure has been filled up another fissure has been opened by its side, and that again filled up. In one case at Redruth, Cornwall, the process has been repeated six times (Plate II. fig. 17, 1, 2, 3, &c.) The minerals in a vein vary as the rock varies. At Botallack a vein traversing granite with three alternations of slate contains tin in the granite, and vitreous black copper in the slate. There seems also to be a connection between the direction of the vein and the contents. The right-running veins, for example, of Cornwall and Devon contain as a rule tin and copper, while the cross courses contain iron and lead, a fact which may be explained by the view that the fissures were developed at successive times, and therefore filled with materials by water which had picked up the minerals from different areas. If two mineral veins intersect each other their relative age can only be ascertained by their contents, and more particularly by the arrangement of the mineral matter at the point of intersection. If the *combs* (fig. 17, 1, 2, 3, &c.) pass from one to the other without any break, they were filled at the same time. If one set is cut off by the other, the one which is cut off is the older. The age of the fissures is altogether a different question from that of the time of their infilling, and the older fissure, whether fault or not, may have remained without minerals until the newer was formed, and minerals deposited in both from the same body of water.

10. *The Distribution of Ores, and the Sources from which the Heavy Metals and Bases have been derived.*—The contents of mineral veins vary generally according to the amount of percolation of atmospheric water. In the deep and dry workings metals occur in combination with sulphur, arsenic, and chlorine, while in the superficial and wet parts of the same veins they are converted into sulphates, oxides, and carbonates by the descending column of water (see B 9), carrying oxygen and carbonic acid. The heavy metals in the earth's crust are abundant, according to their power of resisting chemical action. Thus iron, easily oxidized, is widely spread, while the refractory gold, iridium, and platinum are rare. From these considerations, as well as from the fact that the heavy metals are accidental only in their occurrence in the crust of the earth, it may be concluded that they constitute the central parts of the earth, and that they have been floated upwards through fissures in combination with sulphur, arsenic, and chlorine. Thus from the examination of the mineral veins we arrive

at the same result as to the constitution of the deeper parts of the earth as that which we have formed from the study of the meteorites and the density of the earth.

(Lyell, "Principles of Geology," tenth edition; Hopkins, *Phil. Trans.*, 1839-42, *Brit. Assoc. Rep.*; 1847; Thomson, *Phil. Trans.*, vol. 154, *Trans. Geol. Soc., Glasgow*, iii. pp. 25, 215; Mallet, "Introd. to Palmieri's Vesuvius;" Forbes, *Jour. Chem. Soc.*, June, 1868; Roscoe, "Spectrum Analysis;" Meunier, "Étude sur les Météorites," 1867; Daubrée, "Géologie Experimentale;" Haughton, "Manual of Geology," Lecture I. and Appendix; Mallet, *Phil. Trans.* 1873, p. 205.)

C. Stratigraphical Geology.—This treats of the arrangements of the rocks on the earth's surface, and of their relation to each other; and is, in short, the history of the formation of the earth's crust. It deals with all the rocks, but more especially with the fragmental division, in which the strata are classified in due order with reference to the time of their deposit. In ascertaining the relative antiquity of rocks, lithological character is only valuable for small areas, since different deposits are being formed at the same time—shingle in one place, sand and mud in others, while in the deeper seas calcareous matter is being accumulated. The same stratum in our seas is not of uniform constitution. The shingle and sand of the eastern coasts of Britain differ from those of the western—the former being composed for the most part of flint, chalk, and other Secondary rocks; and the latter of quartz and the harder rocks of the Primary age. Strata, too, of the same mineral constitution are proved by their position to be of widely different ages. The Old Red Sandstone, for instance, cannot be distinguished mineralogically from the New Red Sandstone or Triassic rocks, although they are separated from one another by the Permian and Carboniferous rocks. Colour, texture, and physical character generally are only valuable therefore as local guides. It is only by a careful examination of the mode in which the rocks are piled one over another that the true sequence can be ascertained. The lower are obviously older than those above them, unless the true sequence has been disturbed, as it sometimes has been, by the rocks having been inverted. It does not, however, follow that one rock immediately overlying another has been strictly consecutive; it sometimes happens, as in the case of Plate II. fig. 13, that there is a geological break or unconformity between the two, implying a geographical change, and a very considerable lapse of time. Newer strata may rest upon any that are older, as may be seen in the sandbanks on our shores, covering water-worn surfaces of rocks ranging from the Archæan to the most recent deposits. Nor are strata which are parallel or conformable to each other always consecutive. The Thanet sand in south-eastern England, belonging to the Eocene formation, is conformable to the chalk below, although in the interval between the two the great changes both in life and geography took place defining the Secondary from the Tertiary periods. The relative age of rocks is also marked by the included fragments in the arenaceous and argillaceous groups, the newer being built up of fragments of the older. It is, however, mainly by an appeal to the traces of life which they contain, or the fossils, that it is possible to arrange the stratified rocks over the whole world into one series. For this purpose, as the rocks are for the most part of marine origin, marine forms are the most important, and since most of the types are terrestrial in the vegetable kingdom, we are compelled to rely upon the animals. Of these the invertebrates, from their low organization and wide dispersal, are of higher classificatory value than the vertebrates, the higher forms of which only appear late in geological time. For the Tertiary period, however, the Mammalia, the highest of the vertebrates, afford the best means of classification, since they alone changed with sufficient swiftness to mark the various subdivisions. The fossils generally occur imbedded in the rock, in the localities in which they lived—the littoral shells and other organisms buried in the accumulations on and near the sea-shore, and the deep-sea types of life in the calcareous accumulations of the deep sea. In using the fossils as an index to the age, therefore, only those from the same habitat must be compared together—those from sandstones, limestones, &c., with those from like accumulations. If there be a difference too considerable to be accounted for by the existence of colonies side by side, the rocks containing them belong to different ages, and the amount of that difference in age is marked by the difference in the groups of fossils.

If we, further, compare fossils from various parts of the world and rocks of different ages, it will be seen that life as a whole on the earth has passed through definite stages, and that each geological period has its own peculiar types. Each of these periods is characterized by the absence of some forms living in the preceding age, and by the presence of new forms, which in their turn again in the long course of time for the most part disappear. The rocks are classified by these changes of life into three divisions:—

3. The Tertiary or the Kainozoic.
2. The Secondary or the Mesozoic.
1. The Primary or Palæozoic.

The sequence of life is regular, definite, and orderly in the rocks over the whole earth, and consequently the classification of the European rocks applies equally in its broad divisions to those of the Americas, Australia, India, or Africa.

If the series of rocks were complete, and all the forms of life were preserved in them, we should have a perfect record. But this cannot be, since the strata are composed mainly of the fragments of older rocks (see B 5). Nor do the fossils which they contain give us more than a clue to the fauna and flora living at the time, but few traces of which would be buried in the strata. Those few would be liable to be destroyed along with the rock after they became fossilized by the denuding agencies by which the fragmental rocks themselves have been formed. But if they had been preserved there is yet the chance of their not being discovered. Consequently the "geological record" is imperfect both as regards the rocks and the life, and the older portions are those which are the most imperfect, because they have been exposed for a longer time to the destructive forces. We cannot, therefore, look for a perfect history of life in the rocks, or for evidence of all the changes by which the infinite variety of the animal and vegetable kingdoms has been produced. The evidence which we have is, however, conclusive that in the oldest rocks the lowest and most generalized types appear, and that in the long course of geological time the higher forms came upon the scene in the same order in which they are classified by the naturalists—fishes, amphibians, reptiles, birds, marsupials, placental mammals, and last of all man.

In reading the time on the geological clock by the fossils it is important to understand clearly the difference between geological and historical time. In the former, groups of rocks containing similar groups of life are considered to be of the same age, because they contain similar groups of life; but it does not follow that they are contemporaneous. Indeed if they be remote from each other, as Huxley has pointed out, they were probably formed at successive times, because it would demand a long time for a fauna or a flora to migrate from the area of the one to that of the other. We can only say that they belong to the same life-stage in geological classification, or are "homotaxially" of the same age. Nor in the study of the rock or of life have we any proof of the rate of the accumulation of the one, or of the time necessary to produce changes in the other. Nor can we measure the interval between any two geological periods by any other method than the changes in geography and in

life. We only know the sequence of events, and have no means of judging the lapse of time during which the events were brought about, or the length of the intervals. Consequently we cannot fix the date in the historical sense. We have no natural chronometers which record the passage of the years, and therefore all attempts to measure the geological past in terms of years are futile. In historical time we know not merely the sequence of events, but how long they took, and the length of the intervals between them, because they are down in written records. It is only possible to measure the years within the time covered by the chronicles of the historian.

The cause of the extinction of old, and the appearance of new forms of life must now be considered. Darwin has shown that the present variation in the forms of plants and animals is largely due to their environment, and that the present face of nature is the result of a struggle for existence among organisms which are produced in such numbers that the favoured ones only can survive. A slight change in the environment, the introduction of a new plant, as for example clover, or of a new animal, such as the rabbit, into Australia disturbs the equilibrium, and the weaker forms are beaten and become exterminated. Changes of climate would affect the fauna and the flora of a district most profoundly, and changes in geography by which two regions before isolated by a tract of sea became united, would cause a severe competition between the organisms in possession and the invaders. The close of each of the great life-periods is marked by a geographical change, by which the sea-bottom was lifted up and tracts of land hitherto isolated by sea brought into communication with each other. It is therefore not at all strange that many types of life in sea and on land should have been destroyed in consequence of these changes. They were merely beaten in the struggle for existence, and had to yield their place in nature to those better fitted for it - to the invading forms. The sum of the food on the earth available for plants and animals having been through all geological time practically the same, the stronger forms only survived. In this manner the extinction of old species and the appearance of new may be explained, rather than by the old hypothesis which accounted for the one by an overwhelming destruction, and for the other by a fresh creation, but which leaves without explanation the fact that some species, and more particularly those of low organization, survived the changes during which their fellow-species perished.

We can, then, classify the stratified rocks first by examining the order in which they rest upon one another, and by noting the fossils which they contain. A *bed* or a series of beds characterized by the same fossils is termed a *zone* or *subdivision*, and two or more zones less closely linked together constitute a *division*. The allied divisions constitute a *formation*, and the allied formations a *group*.

ZONES OF

Ammonites Bucklandi,
Ammonites Planorbis, &c. } = Division, *Lower Lias.*

DIVISIONS.

Upper Lias, . . .
Middle Lias, . .
Lower Lias, . . . } = Formation, *Liassic.*

FORMATIONS.

Cretaceous, . . .
Oolitic, ...
Liassic, ...
Rhætic, ...
Triassic . . . . } = Group, *Secondary.*

The term *series* is used when it is necessary to form a class intermediate between *division* and *formation*, as in the Lower and Upper Cambrians; *period* is applied without any technical meaning. The reader must, however, bear in mind that scarcely any two authors are agreed as to the class-names of the rocks. In the table on next page the rocks are given in the order in which they occur, and under the names by which they are known in Britain.

The names of the rocks are based upon lithological character, such as Red Sandstone or Oolite; or geographical, as Cambrian, Silurian, and Permian; or local, as Lias and Cornbrash. They are used, irrespective of their original derivation, to designate rocks containing the same groups of fossils.

(*a*) *The Primary or Palæozoic Group*: 1. *The Archaian Formation* (see Map).—The most ancient stratified rocks all over the world are of the same character, consisting of gneiss, mica-schist (fig. 11.), quartzite, &c., in which the alteration by heat has been so profound as to develop the crystalline structure in strata originally fragmental, and in some cases to obliterate it altogether. They have, too, been subjected to so much lateral pressure that they are contorted and twisted into a labyrinth of folds, and they are so closely associated in their lower parts with granite as to lead some writers to consider that the latter is merely the result of a still higher stage of metamorphism. The limestones which are locally present have been converted into crystalline marbles (Plate I. fig. 12) and infiltrated with various minerals, such as serpentine. They are termed Archaian by Dana, and have been divided in North America, where they occupy an enormous area, into the Laurentian and Huronian; and in Britain into four divisions, the Lewisian, Dimetian, Arvonian, and Pebidian. The latter classification, however, is not generally accepted. The relation of the Archaian to the rocks above is shown in figs. 16, 18. At their base, granite and granitoid rocks occur in Wales and Scotland, and in the former locality the ejecta of volcanoes add considerably to the thickness of the formation. The principal areas in Britain where the Archaian rocks come to the surface are those in the Hebrides, the north-western border of the Highlands of Scotland; the island of Anglesey, the Menai Strait (figs. 16 and 18), the Lleyn Peninsula, St. Davids, and the Lizard; and in the north-west of Ireland, in Connemara. They constitute islands surrounded by newer rocks in Charnwood Forest, near Church Stretton, and at Malvern. On the Continent they form a large part of the Scandinavian Peninsula, and have been recognized in various other regions. In the associated beds of altered limestone in North America, Bohemia, and Connemara traces of life have been met with referred by Dawson and Carpenter to a foraminifer, Eozoon. The beds of graphite, too, which occur in it in Canada are probably altered layers of vegetable matter. Thus in these lowest rocks the animal and vegetable kingdoms are represented, and the former by one of its simplest members. It is very probable, from the great thickness of the Archaian strata—about 30,600 feet in Britain and 50,000 in North America—on both sides of the Atlantic, that the ancient continent from which they were torn was in the area now sunk in the depths of the Atlantic. The isolated portions of them which are scattered over the present surface of Europe prove that in the Archaian age our quarter of the world was buried under the sea. These deposits were altered into the fragmento-crystalline state, and crumpled and folded by being sunk to a profound depth beneath the present surface, under the pressure of a weight of rock of which we now have no trace. Then they were lifted up and formed the western and north-western land, against which beat the waves of the Cambrian Sea. All these vast changes took place after the consolidation and metamorphism of the Archaian rocks, and before the strata now overlying them were deposited in Europe and America. The Cambrian rocks are not merely immeasurably later in point of time, but are in their lower parts composed of pebbles torn from the Archaian cliffs, out of the ruins of which they are to

THE ORDER OF THE SUCCESSION OF THE STRATIFIED ROCKS IN THE CRUST OF THE EARTH.

		Thickness in Ft.	Characters in British Isles.
III. Tertiary or Kainozoic Group.	6 Historic Formation.		Surface accumulations, sands, shingle, peat, alluvium, caves.
	5 Prehistoric Formation.		Surface accumulations, peat, alluvium, shingle, caves.
	Age of Iron.		
	Age of Bronze.		
	Age, Neolithic,		
	4 Pleistocene Formation,		Brick earths, gravels, marine shingle, boulder clays, land-surfaces, caves.
	Postglacial,		
	Glacial,		
	Preglacial,		
	3 Pliocene Formation,	100	Marine and fluvio-marine sand and gravel, shell beds, phosphatic deposits.
	Norwich Crag,	20	
	Red Crag of Norfolk,		
	Coralline Crag,		
	2 Miocene Formation,		Lignites and volcanic ejecta, lacustrine accumulations, marine and fresh-water sands, gravels, clays, and limestones.
	1 Eocene Formation,		
	Postnummulitic,		
	Nummulitic,	1270	
	Prenummulitic,	730	
II. Secondary or Mesozoic Group.	Cretaceous Formation	2000	Marine shingle, sands, sandstones, clays, and calcareous deposits; phosphatic deposits; fresh-water clays, sands, sandstones, and limestones.
	Upper { Chalk,	800–900	
	Upper { Upper Greensand,	150	
	Upper { Gault,	200	
	Lower = Neocomian = Lower Greensand, Wealden,	850–1500	
	4 Oolitic Formation,	3120	Marine sands, sandstones, clays, and limestones; fresh-water do.
	Upper { Purbeckian, Portlandian, Kimmeridgian, Corallian, }	920	
	Middle = Corallian, Oxfordian, Callovian,	850	
	Lower = Bathonian,	1150	
	3 Liassic Formation,	1200	Marine strata.
	2 Rhætic Formation,	100–150	Marine strata.
	1 Triassic Formation,	4750	Marine sandstones, and clays and marls, with salt.
	Red Marl series, or Keuper,		
	Red Sandstone series, or Bunter,		
I. Primary or Palæozoic Group.	6 Permian Formation,	500–3000	Marine sandstones, clays, marls, and limestones.
	Red Marls,		
	Magnesian Limestone,		
	Lower Red Sandstone,		
	5 Carboniferous Formation,		Marine sandstones, clays, shales, and limestones; brackish water accumulations; beds of coal on old land-surfaces.
	Coal Measures,	8460	
	Millstone Grit,	5500	
	Carboniferous Limestone and Yoredale Shale,	7000	
	4 Old Red Sandstone Formation,	—	Conglomerates, sandstones, marls, fresh water or marine.
	Upper Holoptychius Beds,	—	
	Lower Cephalaspis Beds,	16,200–20,000	
	Devonian Formation,	—	Marine sandstones, shales, slates, and limestones.
	Upper,	3000	
	Middle,	9400	
	Lower,	1500	
	3 Silurian Formation,	—	Marine sandstones, shales, slates, and limestones; volcanic rocks.
	Upper { Ludlow Division,	1950* 1830†	
	Upper { Wenlock Division,	1600 4000	
	Upper { Upper Llandovery Division,	1500 800	
	Lower { Lower Llandovery Division,	1000 1000	
	Lower { Caradoc and Bala Division,	6000 12,000	
	Lower { Llandeilo Division,	4000 4500	
	Lower { Arenig Division,	4000 10,000	
	2 Cambrian Formation,		Marine sandstones, shales, flagstones, slates, volcanic rocks.
	Upper { Tremadoc Division,	2000	
	Upper { Lingula Flag Division,	3100	
	Lower { Menevian Division,	600	
	Lower { Harlech and Longmynd Division,	8000	
	1 Archaian Formation,	—	Highly altered sandstones, clays, and limestones; volcanic rocks.
	Gneiss, Mica-schist, &c.,	30,000	

* Geikie. † Lyell.

a large extent composed. The "geological break" between the two formations is of the first magnitude (figs. 16, 18).

2. *The Cambrian Formation* (Map).—The Cambrian formation, first recognized by Sedgwick in Wales, is, as might be expected from the vast changes which took place in the interval between them, physically different from the rocks below, consisting of shales sometimes converted into slates (Plate I. figs. 5, 6), and conglomerates and sandstones generally but slightly altered. They are usually gray or reddish in colour, constituting the *graywackes* of the older writers, and may be inferred to have been deposited in shallow water from the ripple marks, sun cracks, and false bedding which are to be observed in them. They occur in the areas mentioned in the preceding paragraph, resting on the Archaian rocks. (Plates II. III.) In Wales they are classified by Hicks as follows:—

		Feet.
II.	UPPER CAMBRIAN SERIES (Lyell). Middle Cambrian (Sedgwick). Primordial Silurian (Murchison).	
D.	Tremadoc flags and slates, ...	1000
C.	Lingula flags, consisting of sandstones, shales, and slates, ...	5100
I.	LOWER CAMBRIAN SERIES (Sedgwick, Hicks). Cambrian (Murchison).	
B.	Menevian sandstones, flagstones, slates, shales, blue or gray, ...	600
A.	Longmynd and Harlech, ...	2300
	Gray, purple, and red conglomerates, sandstones, flags, and shales, ...	8000

The Cambrian formation contrasts with the Archaian in the richness of its fossil contents, in which all the divisions of the Invertebrata are represented, being as clearly defined from each other as at the present day. Some of the simpler forms, such as Lingulella, differ from living species only to a slight degree; while the highest, the Trilobites, belong to an extinct order among the Crustacea.

3. *The Silurian Formation* (Map, see also figs. 16, 18, 19).—The Silurian formation, first explored by Murchison in the tract formerly inhabited by the Silures and the adjacent counties of England, rests conformably upon the Cambrians below, and passes gradually into the Old Red Sandstone above. It consists of gray, black, and reddish strata, conglomerates, sandstones, and shales, with subordinate layers of limestone occupying a large part of Wales. It also spreads over a large tract in Cumbria and in the Highlands of Scotland, in which the lower series is profoundly affected by metamorphism, and rests unconformably on the Cambrians. In Wales, too, there is an unconformity between the lower and upper series, which led Sedgwick to include in his Cambrians the whole of the Lower Silurians as defined in the table of strata. It may, however, be inferred from the many species of high organization which pass from the one to the other that it is a local phenomenon, not implying such changes as would mark the boundary of a *formation*. The Silurian rocks occupy an enormous area in Europe, Asia, and America, as well as in the Australian continent. In the Silurian age volcanoes were active in Cumbria and North Wales (Plate II. fig. 16 *a*), and poured forth lava streams and ashes which are interbedded with the marine accumulations. In the Silurian age new types of life appear, and in the Ludlow subdivision we meet with the first traces of vertebrates, belonging to the ganoid and placoid fishes, such as Scaphaspis, Cephalaspis, and Onchus. The family of Graptolites occurs throughout the formation, and the Trilobites abound—the *Ogygia Buchii* in the lower, and the *Phacops caudatus* in the upper division. The gigantic crustacean Pterygotus is common to the Upper Silurian and to the Lower Old Red Sandstone formations.

4. *The Old Red Sandstone and Devonian Formations* (Map).—The Old Red Sandstone and Devonian formations are grouped together because the one was accumulated in lakes, probably of fresh water, at the same time that the other was being deposited beneath the waters of the open sea. The Old Red Sandstone in Herefordshire, Brecon, Monmouth (Plate III. fig. 20), and Carmarthen is not less than from 8000 to 10,000 feet in thickness, consisting of red and green marls containing calcareous nodules and white and chocolate-coloured sandstones and conglomerates, the red colour predominating.

In Scotland and in the Orkneys the Upper Old Red Sandstone, with Holoptychius, rests unconformably on the Lower, which reaches a maximum thickness of 16,200 feet. The lakes in which these deposits were formed covered the Orkneys, Caithness, and the region north of the Grampians, the central valley of Scotland, the Cheviots, and the English border of Northumberland, a small tract north of Argyle, and the south Welsh area, as defined in the Map. They also occupied part of the north and south of Ireland. The fresh-water *Anodon Jukesii* is the only mollusc found in these lakes, and it occurs only in the upper deposits along with ferns and lycopodiaceous plants. The fishes are mainly ganoids belonging to extinct types—Cephalaspis, Pteraspis, Coccosteus, Holoptychius, &c. The marine equivalents of these deposits in Devonshire contain numerous corals and mollusca, and have been considerably affected by metamorphism; they consist of three divisions—the lower or the Lynton, the middle or Ilfracombe, and the upper or Barnstaple group. In the last are numerous land plants, also of Carboniferous types. The Old Red Sandstone fishes and the Devonian marine fossils are found side by side in Germany and Russia. *Clymenia undulata*, *Spirifer disjunctus*, *Bronteus flabellifer*, and *Calceola sandalina* may be remarked among the characteristic marine fossils.

5. *The Carboniferous Formation* (Map, see also figs. 13, 21, 22).—The Carboniferous formation rests conformably on the Old Red Sandstone, and unconformably on the older rocks, as in figs. 13, 21. In Lancashire and Yorkshire it has a maximum thickness of 20,960 feet, and consists chiefly of marine strata with some fresh-water and estuarine beds. If the above district be taken as a type, the massive carboniferous limestone forms the bottom, 5000 feet thick in Derbyshire, and above which are the Yoredale shales, millstone grit, and the coal measures, the seams of workable coal not being found below the middle portion of the millstone grit. In tracing these beds northwards the coal seams gradually descend, and are intercalated with the carboniferous limestones in Durham and Northumberland, and in Scotland occur below in a series of red and purple sandstones which constitute the calciferous sandstone subdivision. The millstone grit (—Rosslyn or moorstone sandstone in Scotland, and the "farewell rock" in Somerset) is persistent throughout Britain north of Devon, while the Yoredale shale is a local deposit not found south of Derbyshire and Stafford shire. The coal measures in Lancashire are divided into three subdivisions—the lower coal measures, characterized by Goniatites and Aviculo-pecten and other marine shells, and containing but few seams of coal; the middle, with the fresh or brackish water Anthracosia, and containing the most valuable coals; and the upper, characterized by the abundance of Spirorbis, a tiny annelid, and with a few valuable seams of coal in its lower parts. These three subdivisions are represented in Scotland by the upper measures.

The vertebrates are abundantly represented by fossil ganoids and sharks, and the amphibians appear for the first time—the Labyrinthodon and other forms. Among the animals living in the sea were the *Euomphalus pentangulatus*, *Goniatites Listeri*, *Spirifer striatus*, *Productus giganteus*, and *Aviculo-pecten papyraceus*. On the land, scorpions and beetles and centipedes lived in the

midst of a vegetation composed of Lepidodendra, Sigillaria, calamites, and various coniferous trees, with a dense undergrowth of ferns. The coal seams (Plate I. fig. 10) are formed by the vegetation growing on the land and accumulated on horizontal tracts of alluvium submerged from time to time, and their presence in the Lower Carboniferous rocks of Scotland proves that there was land in that region while the carboniferous limestone of Middle England was being formed at the bottom of the sea. The culm measures of Devonshire, with their earthy coal, also point to the existence of land at that time in the south-west of England, and the conglomerates on the water-worn Silurian rocks under the carboniferous limestone (Plate IV. fig. 21) of North Wales imply that the Carboniferous sea beat upon cliffs of Upper Silurian rock in the North Welsh area, while the Old Red Sandstone area of South Wales was gradually sinking. The horizontal alluvia of the coal measures extended from these areas southwards over North France, eastwards over Belgium and Holland into Germany, and westwards over the greater part of Ireland. The present coal-fields are merely those portions of them which have been isolated from each other by denudation after they had been thrown into folds and traversed by faults at the close of the Carboniferous age and afterwards. The salient or anticlinal folds have for the most part been removed, leaving the re-entering or synclinal, to which is due the shape of the present fields. The Pennine chain is carved out of one of these great anticlinals running north and south (Plate IV. fig. 22). Another axis of disturbance ran east and west, from the area of the Mendip Hills in Somerset, through Pembrokeshire into the South of Ireland, and eastwards through North France into the district of Artois. Along this "axis of Artois" the strata are crumpled and faulted to such a degree that in the Radstock Colliery, in Somerset, one seam of coal is pierced three times in one vertical shaft. These profound disturbances took place in the interval between the deposit of the upper coal measures and that of the overlying Permian formation.

6. *The Permian Formation* (Map).—The red rocks overlying the eroded surfaces of the Carboniferous strata (fig. 23), and underneath the Triassic formation, derive the name of Permian from their true relations having been first recognized in the ancient kingdom of Perm, now a Russian province. They occupy comparatively small and isolated tracts in Britain, and were evidently accumulated in land-locked seas. In Manchester and on the western flanks of the Pennine chain they consist of red sandstone 350 feet, covered by red marl with calcareous nodules 233 feet thick. On the eastern side the red marls contain layers of magnesian limestone 300 feet thick. In Shropshire and Worcestershire they are marls, sandstones, and thick breccias and conglomerates. The fossils are few and unimportant, and consist mainly of Carboniferous genera, such as the Fenestella and Productus, and among the fishes, Palaeoniscus and Acrolepis. *Schizodus Schlotheimi* and *Bakevellia tumida* are among the characteristic mollusca.

(*b*) *The Secondary or Mesozoic Group.*—The great geographical changes which took place at the close of the Carboniferous period caused changes in the conditions of life which attracted new forms of life in the succeeding period, and which caused the Carboniferous genera which survived to become dwarfed. Another great geographical change took place at the close of the Permian, by which the Permian species became exterminated and replaced by the new forms which migrated into Europe from the area then brought into contact with it, and appear in the Triassic rocks resting on the water-worn and eroded surface of the Permian strata (fig. 23). This geological break closes the Primary or Palaeozoic section of the history of the stratified rocks.

1. *The Triassic Formation* (Map).—The Triassic rocks (fig. 23), which form the lowest of the Secondary or Mesozoic group, owe their name to the fact that they consist of three divisions in Germany and France—the ***Bunter sandstein = Grès bigarré***; the ***Muschelkalk = Calcaire coquillier***; the ***Keuper = Marnes irisées***. In Britain the marine limestone of the second is wanting, and the red sandstones and marls of the first and third, formed in shallow water, constitute the formation otherwise known as the New Red Sandstone. They are subdivided by Hull as follows, in Lancashire and Cheshire:—

		Feet.
Keuper or Red Marl Series.	5. Red and Gray Marls, with rock-salt and gypsum, ...	3000
	4. Water stones or Lower Keuper Sandstones, ...	500
Bunter or Red Sandstone Series.	3. Upper Mottled Red and Gray Sandstone, ...	500
	2. Pebble Beds, ...	650
	1. Lower Mottled Red and Gray Sandstone, ...	200

Vast quantities of water are stored up in the Bunter and the Waterstones, which affords an ample supply to the towns in the neighbourhood, and the rock-salt occurring in lenticular masses in the red marl, is of enormous commercial value. One of these masses is 151 feet thick at Northwich in Cheshire. It is derived from the evaporation of sea-water in landlocked areas such as the Dead Sea, and its presence implies that the main body of the ocean was shut off by a barrier from the area in which it is found, and that the sun-heat was sufficiently great to lift up the water faster than it could be supplied by the rainfall. These strata are widely distributed over Europe, Asia, South Africa, and North America. In Britain they contain but few fossils, consisting chiefly of fragmentary remains of the extinct land reptiles, the Dinosauria, and their hand-like footprints (Cheirotherium). One of the most characteristic fossils in the Muschelkalk is the *Ceratites nodosus*.

2. *The Rhætic Formation.*—The sandstones (Plate IV. fig. 23), black shales, and white limestones, which rest regularly on the upper surface of the Keuper marls, and are classified by some with the Triassic and by others with the Liassic formations, are considered by Gumbel to be distinct from both, and constitute the Rhætic formation, from their development in the Rhætian Alps. In Britain they consist of three divisions—the Lower Rhætic or Gray Marlstone, 84 feet; the Middle or Black Shales, with *Avicula contorta*, 25 feet; the Upper or White Lias, 17 feet. These constitute passage-beds from the Triassic to the Liassic formation, but are mapped off from both by the possession of peculiar fossils, such as *Avicula contorta*. They contain vast numbers of fossils, and more particularly fishes and reptiles in the lower and middle divisions, which constitute well-defined "bone-beds." In the lower beds the fossil mammalia are represented by the Microlestes, a tiny marsupial about the size of a rabbit; and in them and in the beds above are the first traces of the great marine reptiles—Ichthyosaurs, Plesiosaurs, and the flying reptile the Pterodactyle, which range through the rocks from this point up to the top of the Secondary group.

3. *The Liassic Formation.*—The Liassic formation (Plate V. fig. 24) derives its name from the thin layers of limestone in its upper and lower divisions. It rests conformably upon the Upper Rhætic beds, which everywhere occur at the foot of the scarp composed of its lower rocks, and it is composed of three well-marked divisions—the Lower Lias clays and shales, with their limestones, 120 feet; the Middle Lias or Marlstone, a calcareous sandstone locally converted into iron-stone, 150 feet; the Upper Lias clays, ranging from 200 to 500 feet thick in Yorkshire to 6 to 8 feet in Somerset. These rocks are characterized by vast numbers of peculiar forms of Ammonites and Belemnites, two

cephalopods which are widely spread through the whole of the marine Secondary rocks above the Lias. The other invertebrates abound, and the fossil fishes and reptiles are preserved in great perfection. Numerous remains of plants prove that at this time the vegetation was composed of conifers and cycads. Among the characteristic forms are *Gryphæa incurva*, *Lima gigantea*, *Rhynchonella tetraedra*, *Terebratula punctata*, &c.

4. *The Oolitic Formation.*—The Oolitic formation (Plate V. fig. 24), so called from some of the limestones being composed of small grains like the roe of fish, each formed of coats of carbonate of lime (Plate I. fig. 8) round an organic centre, rests conformably on the Lias, and is grouped with it by most continental geologists under the name of Jurassic (see Map), from the occurrence of these rocks in the Jura. It consists of three massive limestones separated by two thick beds of clay, and contains subordinate beds of sand and sandstone. It is divided as follows:—

		Maximum Thickness. Feet.
Upper Series,	*f.* Purbeckian or the fresh-water and marine strata of the island of Purbeck,	360
	e. Portlandian, or limestones and sands of Portland,	230
	d. Kimmeridgian, or clay of Kimmeridge,	600
Middle Series,	*c.* Corallian, or coral rag and calcareous grit,	250
	b. Oxfordian, or clay of Oxford,	600
Lower Series,	*a.* Bathonian, or Bath limestone, clays and sands, cornbrash, Forest marble, Great Oolite, fullers' earth, Inferior Oolite,	115

These deposits vary considerably in thickness, and were deposited for the most part in seas not far from the land, along with numerous fragments of ferns, equiseta, and coniferous plants, insects, and other wings and strays. The Purbeckian fluvio-marine division is found only in Southern and Eastern England, in Dorset and Sussex, and has been traced as far north as Oxfordshire. The Portlandian marine strata range as far north as Buckinghamshire. The strata below the Great Oolite in Yorkshire consist of shales, ironstones, and sandstones 750 feet thick, with vast numbers of cycads and ferns, and one seam of coal 16 inches in thickness. At Brora two seams of coal in this deposit measure 18 and 44 inches respectively. Lower jaws of *Phascolotherium Bucklandi* and other mammals in the "Stonesfield slate," beneath the Great Oolite, and the Plagiaulax and others of the Purbeckian strata, prove that small marsupials still inhabited the land. The presence, too, of birds is shown by the discovery of the long-tailed *Archæopteryx macroura* of the lithographic slate of Solenhofen, which belongs to the Corallian division. The gigantic Dinosauria, however, were masters of the land—the Megalosaurus, Ceteosaurus, and their allies. From among the large numbers of characteristic marine forms the following may be selected as types:—*Rhynchonella spinosa*, *Terebratula maxillata*, *Trigonia costata*, *Gryphæa dilatata*, *Ostræa delto-idea*, *Ammonites Jason*, *Belemnites abbreviatus*, and *Perna quadrata*.

The Wealden strata (Map, see also fig. 25) of Kent, Sussex, the Isle of Wight, and Dorset consist of fresh-water sands and clays. They form, with the Purbeck strata below, one great fresh-water deposit common to the Portlandian and Neocomian divisions.

5. *The Cretaceous Formation.*—The Cretaceous formation (Map, see also figs. 25, 26), deriving its name from the chalk, rests conformably on the Oolitic, and consists of the following series in Britain:—

		Feet.
Upper,	Chalk,	958
	Upper Greensand of Blackdown,	200
	Gault,	150
Lower,	The Lower Greensand or Neocomian,	500
	(Wealden),	1100

The Neocomian strata are variable in character, and are chiefly remarkable for the valuable phosphatic bone-bed which they contain in Cambridgeshire, Bedfordshire, and part of Buckingham. Numerous remains of the Dinosaurs, Iguanodon, &c., have been met with in this division, both in the fresh-water and marine strata.

The gault is a stiff blue calcareous clay highly fossiliferous, and containing many phosphatic nodules. The upper greensand of Blackdown is an arenaceous deposit in Devon and Somerset with fossils closely allied to the gault, while that of Warminster and the glauconitic sands and marls of Eastern and South-eastern England belong to the chalk. At Folkestone there is a gradual transition from the sandy beds, highly charged with glauconite, into the chalk marl, and from that into the chalk, which is not less than 850 feet thick in the Straits of Dover. The chalk is formed of comminuted shell and vast numbers of foraminifers (Plate I. fig. 7), and was accumulated at the bottom of a deep sea, like the "Globigerina ooze" of the Atlantic. The layers of flint characterizing the upper part in the south of England, but descending to the bottom in the gorge of the Humber, are concretions of silica formed round organic centres, generally sponges, and are petrified in the position in which they lived. The silica has been secreted from the sea water by diatoms, polycistineæ and sponges.

The most characteristic mollusca of the Cretaceous sea are ammonitoid shells which exhibit every variation of form, from the closely-curled Ammonite to the uncurled and straight Baculites—*Ancyloceras gigas*, Neocomian; *Hamites rotundus*, Gault; *Baculites anceps*, Chalk. Among the Gasteropoda the *Pterocerus Fittoni*, Neocomian; and among the Sponges *Ventriculites radiatus*, Chalk, are worthy of remark.

The changes in the geography of Britain in the Secondary age were on the whole unimportant and local. During the Triassic age, Cornwall, the Pennine Hills, Cumbria, Wales, and the higher grounds of Scotland were dry land washed by a shallow sea. In the Liassic, Oolitic, and Cretaceous ages the areas of sea were gradually filled with a succession of strata which now appear as broad bands running (see Map) diagonally across Britain to the south-east of a line running from the mouth of the Tees to the Severn. While this was going on the area was sinking, and at the close of the Secondary period had sunk so deep as to allow of 958 feet of chalk being accumulated in the sea then covering South eastern England. At the close of the Cretaceous age the area was lifted up above the sea, and a migration of new forms of life in the sea and on the land took place, from some region as yet not known; and the Secondary types of life, beaten in the struggle for existence, became extinct. The arrival of this new fauna in Europe characterizes the Tertiary period.

(c) *The Tertiary Group.*—The Tertiary or Kainozoic strata (Map) are characterized by the presence of the remains of the new-comers that took possession of the land, the sea, and the air, and in the long interval between the time of their arrival and the present day present a steady progress towards the present fauna. The percentage of living species grows larger the nearer we come to our own time, and afforded Lyell the basis of his classification. The invertebrates, however, have not changed fast enough to mark the later Tertiary formations, and it is only when we appeal to the placental mammals that the progress has

been sufficiently swift for the purposes of classification. They appear "en pleine évolution," and allow of our defining the formations as follows:—

	Characteristics.
VI. *Historic*, in which the events are recorded in history.	Historical Record.
V. *Prehistoric*, in which domestic animals and cultivated fruits appear.	Man abundant; domestic animals; cultivated fruits.
IV. *Pleistocene*, in which living species of placental mammals are more abundant than the extinct.	Man appears; living species abundant.
III. *Pliocene*, in which living species of placental mammals appear.	Living species appear.
II. *Miocene*, in which the alliance between living and placental mammals is more close than before.	Living genera appear.
I. *Eocene*, in which the placental mammals now on the earth were represented by allied forms belonging to existing orders and families.	Living orders and families appear.

1. *The Eocene Formation.* The rocks which constitute the Eocene formation (Plate VI. fig. 27) in England rest upon the water-worn surface of the Chalk, and are restricted to the area to the south east of a line drawn from Portland to the Wash, being mainly massed together in two basins termed respectively that of London and Hampshire. They are divided into three divisions, according to the absence or presence of a foraminifer, Nummulites, as follows:—

		Feet.
Upper or Post-nummulitic,	Hempstead Beds—fresh-water, estuarine, marine, ...	170
	Bembridge Beds, ...	80
	Osborne or St. Helens Beds—fresh-water, estuarine.	100
	Headon Beds—fresh-water, estuarine, marine, ...	260
Middle or Nummulitic,	Barton sands and clays—marine,	300
	Bracklesham—marine, ...	—
	Bagshot, ...	—
	Alum Bay and Bournemouth Beds—fresh-water, estuarine, marine,	
Lower or Pre-nummulitic,	London clay—estuarine, marine, .	480
	Woolwich and Reading sands; shingle, clay—fresh-water, estuarine, marine, ...	58
	Thanet sand—marine, estuarine, .	39

These three divisions are equally well represented on the Continent. The Upper is grouped by some authors with the beds at the base of the Miocene, under the name of Oligocene.

The Eocene seas teemed with life of various kinds, now for the most part only found in the warmer regions of the ocean, with sea-snakes, gigantic sharks, rays, sword-fishes and sturgeons, with the nautilus, cone, volute, cowry, olive, and spindle-shell. In the lakes, rivers, and seas were turtles, crocodiles, alligators, and long-snouted gavials. On the land the tapir-like Coryphodon, the Opossum, and the Arctocyon make their appearance in the Prenummulitic division, as well as the goose-like Odontopteryx, and the Dasornis, a great bird with a head as large as that of the Man. Another tapiroid, the Lophiodon, appears in the Nummulitic deposits of Bracklesham, while in the upper division the group of animals originally discovered in the Paris basin and described by Cuvier, contain the ancestral forms which combine characters now scattered widely among the living herbivores—the Palæotherium, or the representative of the Perissodactyles; and the Anoplotherium, or that of the Artiodactyles. The Adapis, too, represented the Lemurine division of the Primates on the land, and the Halitherium the Sirenians in the sea. In the air, too, were bats. Among the land-shells it is interesting to note one tiny snail, *Helix labyrinthica*, now living in the United States.

2. *The Miocene Formation.*—It is a question still under dispute as to whether the fluvio-marine deposits at Hempstead, 170 feet thick, belong to the Miocene or to the Upper Eocene. The small hog like *Hyopotamus bovinus* and the species of crocodiles are identical with French species of Lower Miocene age. Nor is the evidence quite clear that the lignites and associated lacustrine beds of Bovey Tracey, in Devonshire, and the deposits with vegetable matter under the lavas and ashes of Mull and the north of Ireland, really belong to the Miocene age, although most of the plants are specifically identical with those of the Miocene of Switzerland. On the Continent, however, the Miocene strata have a large local development, and are characterized by three distinct mammal faunas. In the Lower Miocene in France are found two marsupials, the Didelphis and Hyænodon, and the Anchitherium or three-toed ancestor of the horse—three survivors from the Upper Eocene age—the Hyopotamus, and the living genera Rhinoceros, Tapir, Mustela, Viverra, Squirrel, Hedgehog, Dormouse, Water-shrew, and Mole. These were succeeded in the French Mid-miocene by the Hog, Antelope, Deer, Beaver, and other living genera. The Dinotherium and the Mastodon represent the Proboscidea, and the gigantic Macrotherium the Edentata. A large Anthropoid ape, too, lived in the forests of France and Germany. In the Upper Miocene deposits of Germany, France, Italy, Spain, and Greece four new living genera appear—Giraffe, Gazella, Hyæna, and Porcupine. The Mastodon and the Dinotherium still survived, and apes were abundant (Mesopithecus) in the south and ranged as far north as Eppelsheim in Darmstadt. In the marine accumulations of the Miocene age gigantic teeth of sharks are common (*Carcharodon megalodon*). These and other Miocene fossils occur in the Pliocene deposits of Norfolk and Suffolk, having been derived from the destruction of the Miocene strata in the area of the North Sea.

The view held by some geologists, that there was a period of intense glacial cold in the Miocene age, is, as Saporta observes, negatived by the evergreen vegetation at low altitudes in Middle Europe, which would have been killed by a few hard frosts. The Miocene climate is proved by the plants and animals to have been warm in Central and Southern Europe. Great geographical changes took place at the close of the Miocene age. The lower marine Miocene strata of the Dent du Midi have been lifted up at least 10,940 feet since the Miocene age, and the greater portion of this elevation probably took place before the deposit of the Pliocene strata. A similar upward movement has been traced in the Pyrenees, the Himalayas, and the Sierra Nevada. The axis of disturbance, passing through South-eastern England, giving rise to the Weald, and causing the Eocene strata to be set on end in the Isle of Wight, is most probably one of the results of this general movement in the crust of the earth.

3. *The Pliocene Formation.*—The Pliocene strata of Britain, known as the "crags" of Norfolk and Suffolk (Plate VI. fig. 28), extend over the eastern parts of those counties and over north-eastern Essex, and occupy a small area near Aberdeen. They consist of sands, gravels, and clays, more or less impregnated with iron, and containing numerous shells, most of which are still living in our seas, as well as fossil bones partly derived from the break up of

older formations, and partly contemporaneous. They are classified as follows:—

			Not known as living.
Newer Pliocene of Lyell—			
Westleton Beds, marine,			
Chillesford Clay, "	1–8	?	14
Aldeby Beds, fluvio-marine,			
Norwich Crag, "		112	19
Older Pliocene of Lyell—			
Red Crag, marine. . .	20	218	69
Coralline Crag, marine, .	30	396	144

The Coralline Crag, so named from the abundance of a polyzoon, *Fascicularia aurantium*, is further distinguished from the deposits above by the number of species of molluscs now restricted to the southern seas, and as these disappeared they were replaced by those of the northern seas, the increase in the latter being from 5 per cent. in the Coralline Crag to 10·7 per cent. in the Red, and 14·6 in the Norwich Crag. This implies a gradual lowering of the temperature, which has also left its mark in the blocks of stone transported by floating ice and dropped in the Red Crag. The *Voluta Lamberti* is a survival from the Miocene age, and is probably represented by the *Voluta Junonia* of the Atlantic coast of the United States. Among the mammalia *Mastodon arvernensis*, *Elephas meridionalis*, and *Rhinoceros megarhinus* appear in the Pliocene strata, and the living species are represented by the *Hippopotamus amphibius*, and by deer of Eastern Asiatic type—Axis, Rusa, and their allies. The true horse too appears, differing but slightly in its teeth and feet from living species.

4. The *Pleistocene Formation.*—The Pleistocene strata are characterized by the large number of living mammalia in association with extinct species in caves and river deposits scattered over the face of Europe, and so associated with the boulder clays and marine sands known as glacial and interglacial that the whole forms one series. Out of a total of seventy-eight Pleistocene land mammalia no less than fifty-five are living in some part of the world. These may conveniently be divided into five groups. The first consists of those now living in temperate Europe, Asia, and North America, and includes the following animals:—Mole, musk shrew, common shrew, mouse, beaver, hare, pika, pouched marmot, water-vole, red field-vole, short-tailed field-vole, continental field-vole, lynx, wild cat, wolf, fox, marten, ermine, stoat, otter, brown bear, grisly bear, badger, horse, bison, urus, saiga antelope, stag, roe, fallow-deer, wild boar. The second consists of animals of Arctic habit:—Russian vole, Norwegian lemming, Arctic lemming, varying hare, musk sheep, reindeer, Arctic fox, glutton. The third is composed of those which enjoy the cold climate of mountains:—The snowy vole, Alpine marmot, chamois, and ibex. These animals invaded Europe from Asia, and as the cold increased the temperate group found their way into Southern Europe and Northern Africa, while the Arctic division pushed as far south as the Alps and Pyrenees. The fourth group of invading forms is represented by animals now only found in warm countries:—Porcupine, lion, panther, African lynx, Kafir cat, spotted hyæna, striped hyæna, and African elephant. This group of animals is found as far to the north as Yorkshire, and as far to the west as Ireland. Among the southern animals, too, must be reckoned the hippopotamus, which lived as far north as Britain in the Pliocene age, and in the Pleistocene occurs in caves and river deposits, in intimate association with some Arctic species, such as the reindeer.

The fifth group is composed of extinct species hitherto unknown in Europe—*Elephas antiquus*, *Elephas primigenius*, *Elephas melitensis*, *Rhinoceros tichorhinus*, *Rhinoceros leptorhinus*, *Megaceros hibernicus*, *Hippopotamus Pentlandi*, *Ursus spelæus*, *Myoxus melitensis*. The most important biological fact in the history of the Pleistocene period is the appearance of Man in the rude hunter stage of civilization—the River drift man first, and then the more advanced Cave-man, the former appearing along with the temperate, and the latter along with the northern animals.

The geography of Europe while these animals were in possession was widely different from what it is now. The hundred-fathom line on the west was the Atlantic shore, and the British Isles were the higher grounds in the far west of the continent of Europe. Northern Africa was joined to Europe by way of Gibraltar, Sicily, and Malta, and the islands of the Greek Archipelago were mountains. The climate in the early Pleistocene was gradually becoming colder, and there were oscillations of temperature, which have caused the remains of the northern and southern animals to be associated together in the caves and river deposits from the Alps and Pyrenees as far north as the shores of the Baltic. There were also oscillations of level in Northern Europe, which have left their mark in the marine sands and boulder clays. The Pleistocene strata present great local variations. In the South of Britain the strata with fossil mammalia are divisible as follows:—

Late Pleistocene: Arctic animals abundant north of Alps and Pyrenees; southern animals present; no extinct Pliocene survivals.	The river gravels; the bone caves.
Mid Pleistocene: Arctic animals present; temperate animals abundant; southern animals present; one extinct Pliocene survival.	The lower brick-earths of the Thames Valley; Oreston fissure, with *Rhinoceros megarhinus*.
Early Pleistocene: Arctic animals present; temperate and southern animals present; many extinct Pliocene survivals.	The forest-bed of Norfolk and Suffolk, and associated fluviatile series.

In the north the marine and glacial deposits fall naturally into a series altogether different—the Preglacial marine and fresh-water accumulations; the Glacial marine and terrestrial accumulations—boulder clays, moraines, and the like; and the Postglacial marine and fresh-water strata. These two series are to be looked upon as contemporaneous in different areas, and they can only be brought into relation with each other where they overlap. The Early Pleistocene formation consists of the forest-bed and associated fluviatile strata at the base of the Norfolk and Suffolk cliffs (Plate VI. fig. 29). The forests then growing in the area of the North Sea consisted of Scotch firs, spruces, and yews, oaks and birches, with an undergrowth of sloes, in which *Elephas meridionalis*, *Rhinoceros megarhinus*, and other surviving Pliocene extinct species formed no less than one-third of the mammal-fauna, the mammoth, *Elephas antiquus*, and cave-bear representing the extinct new-comers, the beaver, wolf, fox, stag, roe, and others the temperate group, and the musk-sheep and glutton the northern species. These deposits underlie the boulder clay, and are therefore clearly Preglacial. The Mid Pleistocene division consists of the fluviatile deposits at Crayford, Erith, Ilford, and Grays Thurrock, and contains but one extinct Pliocene survival out of twenty-seven species. Implements of the rude palæolithic river-drift type have been discovered in these deposits, and shells of *Corbicula fluminalis*, now not found in any rivers nearer than the Nile, and the *Unio littoralis*, now found in the Loire. These strata are probably preglacial.

The geographical change in Northern Europe at the close of the Forest-bed age was very great. The forest of

the North Sea sank beneath the waves, and Britain was depressed to a depth of no less than 2500 feet in the area of Wales, and was reduced to an archipelago of islands, composed of what are now the higher lands. The area of the English Channel also was depressed, and the "silver streak" was somewhat wider than it is now, as is proved by the raised beach at Brighton, at Bracklesham, and elsewhere, which marks the sea-line of the largest island of the archipelago, the southern island as it may be termed, the northern shores of which extended along a line passing from Bristol to London. The northern shore of the Continent at this time extended eastwards from Abbeville north of the Erzgebirge, through Saxony and Poland, into the middle of Russia, Scandinavia being an island from which the glaciers descended into the sea.

This geographical change was accompanied by a corresponding change in climate. Glaciers descended from the higher mountains to the sea-level, and icebergs, melting as they passed southwards, deposited their burdens of clay, sand, and erratics, which occupy such a wide area in the portions then submerged of Britain and the Continent.

This depression was followed by a re-elevation, by which the British isles again formed a part of the Continent, and areas of the Channel and of the North Sea again became the feeding grounds of the late Pleistocene mammalia.

The relation of the Late Pleistocene mammalia to these changes in Britain is clearly marked by the fact that the strata in which they are found rest upon the glacial deposits in some places, as at Hoxne, and in others are composed of materials derived from the break up of the glacial beds, as at Bedford (Plate VI. fig. 30). In the glaciated areas they are postglacial, but in the non-glaciated areas south of the line above mentioned they [illegible] also [illegible] glacial or even preglacial, since the northern [illegible]nimals found their way into Britain before the time of th[illegible] boulder clay, and retreated southwards during the extreme glacial cold, returning to the region north of the Thames and lower Severn as the temperature became higher and the land rose from beneath the sea. From these considerations it will be seen that the contents of the Pleistocene bone caves are as likely to be pre- as post-glacial. Those of the cave of Pont Newydd are post-glacial. The rudely chipped implements of the River-drift hunter occur widely distributed through the Late Pleistocene river-beds and caves, in association with the remains of the mammoth, woolly rhinoceros, bison, horse, reindeer, and the like; and the better made implements found in the strata above them in Britain and France imply that their makers, the Cavemen, were later in time and were higher in culture. The associated remains prove that they hunted the same animals, some of which they were in the habit of engraving on their tools. The River-drift man is not represented by any living race of men, while his better-equipped successor, the Cave-man, is probably represented by the Eskimos, who lead a rude hunter and fisher life similar in all respects to that which he led in Europe.

5. *The Prehistoric Formation.*—The Prehistoric strata consists of alluvia, peat-bogs, and beaches, and the contents of caverns containing the remains of animals now living in Europe associated with those that have been introduced by man in a state of domestication. The principal British species are—

Wild Animals.—Beaver, hare, Alpine hare, rabbit, water rat, wild cat, otter, marten, badger, brown bear, grisly bear, wolf, fox, horse, roe, stag, elk, Irish elk, reindeer, urus, wild boar.

Domestic Animals.—Dog (*Canis familiaris*), horse (*Equus caballus*), sheep (*Ovis aries*), goat (*Capra hircus*), shorthorn (*Bos longifrons*, Owen), hog (*Sus scrofa*), marsh-hog (*Sus palustris*, Rült.)

The Prehistoric period is separated from the Pleistocene by an interval sufficiently long to allow of the British area becoming isolated from the Continent, and assuming almost its present contours, and to allow of the extinction of some species and the retreat of others. Its most important feature is the arrival of successive races of men of a different race and of a far higher culture than the Palæolithic River-drift man and Cave-man. The Neolithic farmer and herdsman first appears, bringing with him the arts of polishing stone, pottery-making, mining, spinning, weaving, the domestic animals of the above list, and some of the cultivated seeds. He is identified with the non-Aryan division of mankind still living in Europe, as the small dark Basques. Subsequently the Aryans came in, the ancestors of the present Celtic populations, and bronze became known and then iron, the introduction of each of these metals being accompanied by a higher civilization than that which went before. Thus the Neolithic age was succeeded by the Bronze, and that by the Iron age. The history of Britain begins late in the last of these three divisions.

Several of the domestic animals introduced by the Neolithic farmers, such as the short-horned ox, the marsh-hog, and the goat, reverted to a wild state in the forests as yet untouched by the woodman's axe, and their remains occur in association with those of the wild animals. The domestic horse and the large hog (*Sus scrofa*) may have been introduced as domesticated animals, or they may have descended from ancestors which lived in Britain in the Pleistocene age. The Irish elk is the only species that became extinct in the Prehistoric age.

6. *The Historic Formation.*—It remains for us now to consider the last page of the geological record. The superficial deposits, the loam, the various deposits of streams, the peat-bogs, shingle-banks, and contents of caves, refuse-heaps, the modern ejecta of volcanoes, with remains which allow of our attaching a date, belong to the Historic formation. In Britain the Historic period may be said to begin with the invasion of Julius Cæsar (B.C. 55); in Gaul with the founding of Massilia by the Greeks (B.C. 640); that of Spain, with the founding of Gades by the Phœnicians (B.C. 1100); that of Egypt, with the reign of Menes (B.C. 4000). It is therefore evident that the Prehistoric and Historic periods were in part simultaneous in different parts of Europe. In Britain the chief points to be noted in the fauna are the disappearance of the true elk from the British fauna, and the gradual extermination of the larger wild animals, the brown bear, beaver, wolf, and wild boar. The reindeer still lived on in the north of Scotland, and was hunted in Caithness by the Earls of Orkney as late as 1159. Among the new forms the fallow deer, domestic ox of the urus type, ass, domestic cat, and the common rat may be mentioned. Nor can we separate the Historic or Prehistoric formations from the Tertiary group. It is true that no less than seventeen Pleistocene species have disappeared from Britain in the interval separating the one from the other, some having become extinct, others having retreated to the north or to the south, or to the shelter offered by the forests of Central Europe, or to the cold climate of lofty mountains. It must, however, be remembered that all the wild Prehistoric animals were living in the preceding age, and that from the Pleistocene age down to the present time the wild fauna and flora of Europe have been in their present areas. The continuity has been unbroken. It is therefore evident that the Tertiary period must be extended so as to include the events of our own day.

(Geological Survey of Great Britain—Memoirs and Maps; Dana, "Manual of Geology;" Jukes and Geikie, "Manual of Geology;" Geikie, "Text-book of Geology;" Lyell, "Student's Elements of Geology;" Murchison, "Siluria;" Hull, "The Coal-fields of Great Britain;" Phillips, "The Geology of Oxford;" Dawkins, "Early Man.")

D. PALÆONTOLOGY.—The study of the ancient forms of life has enabled the geologist to classify the stratified rocks over the whole world according to the changes which they exhibit; it has also conferred an equal benefit on botany and zoology by revealing the true relations of the living species, and by showing in some cases their line of ancestry, in spite of the record being, as we have seen, broken and fragmentary. The evolution of the vegetable kingdom could not be expected to be completely illustrated in the rocks formed, as most are of marine accumulations, not merely because the rocks themselves are the result of the destruction of older strata, but because it is only the lowest forms which inhabit the sea. Nor in the animal kingdom do we get anything but a glimpse here and there of those changes by which it has become what it is, until we arrive at the Tertiary period, when the remains of the mammalian dwellers on the land are preserved in great abundance and perfection. We will take the vegetable kingdom first in our brief summary of the geological record.

1. *The Plants.*—The traces of vegetable life are met with, as Dr. Dawson shows, in the oldest stratified rocks, the Laurentian division of the Archæan formation in Canada, in the beds of graphite, which may be masses of Fucoids or even higher plants. Fucoids, too, occur in the Cambrian (Eophyton) and Lower Silurian strata. It is not, however, till we get into the Upper Silurian strata that we meet with indisputable land plants of higher organization. The Psilophyton of Dawson ranges from that horizon to the close of the Devonian formation, and is a "generalized" plant, uniting the characters of a fern to those of a Lycopodium. In the Devonian age, in the United States and in Britain, the vegetation to which in the succeeding age we owe our stores of coal covered the land. Gigantic Sigillariæ and Lepidodendra, now represented by the insignificant Lycopodium; Calamites, now represented by the Equisetum; and various Tree ferns and Conifers (Dadoxylon, &c.) formed the dark and sombre forests, with a luxuriant undergrowth of ferns, Archæopteris, &c. These forests occupied vast areas in the northern hemisphere, and flourished without a break through the Devonian and Carboniferous periods, becoming finally destroyed by the change of conditions at the close of the Carboniferous and Permian formations. The coal seams, the result of their decay on the land, represent an accumulation (fig. 10) which must in some cases have been going on for many ages, when the slowness of the present rate of like accumulations is taken into account. The "main coal" of South Staffordshire is 30 feet thick. We must also bear in mind that the coal-flora grew upon horizontal tracts of alluvium, submerged from time to time, and that we have no remains of the vegetation which grew in the uplands. In spite, however, of this it is very interesting to remark that the Coniferæ are the highest vegetable types which have as yet been discovered in a vegetation characterized by a most wonderful development of extinct types of Lycopodium and Equisetum. The Permian forests contained many survivors from the Carboniferous, but dwarfed and stunted. The genus Walchia is the most abundant conifer, and the true Equisetum appears for the first time. With the close of the Permian age the "reign of the Cryptogams" passed away, and new types, closely allied to living forms, took their place in the forests of the Secondary or Mesozoic period.

The forests of the Secondary period in Europe consisted mainly of Coniferæ belonging to the groups Araucaria, Pinus, Taxus, Cupressus, &c. Zamia and Cycas also abounded, and the screw-pines of the warmer regions of Eastern Asia were represented by the Oolitic Kaidacarpum of Carruthers, belonging to the Endogens. We look in vain for any trace of the angiospermous Exogens in this vegetation till we arrive at the Cretaceous or last stage of the Secondary period, where various kinds of oak, maple, alder, willow, myrtle, proteaceous plants, such as Banksia, Hakea, Grevillea, &c., herald the appearance of a new flora, just as was the case in the Permian, the concluding stage of the Primary period.

The new flora, which spread over the whole earth in the Tertiary period, differed very slightly from that now living, and is characterized by trees with deciduous leaves, which gradually spread further and further south, according to Hooker, Dyer, Saporta, and Asa Gray, from the north polar regions, where they first appear in the Cretaceous age. When once they had been evolved, in consequence of the marked difference between the north polar summer and winter, they rapidly increased in numbers and in diversity of forms. As the polar cold increased and crept southwards, the trees of warm habit, the evergreens and others, were pushed further south, away from their original birthplace, and ultimately only survived in districts now separated from each other by tracts of sea, desert, or mountain. Consequently there is an almost unbroken sequence to be observed in the forests of the northern hemisphere from the Eocene age to the present day, due to a gradual lowering of temperature as far down as the glacial phase of the Pleistocene age. The Eocene vegetation in Britain was of a tropical and Indo-Australian character. The forests were composed of fan and feather palms (Flabellaria, Nipadites), cypresses, sequoias, yews, and pines. There were gigantic aroids, and various representatives of the family of Sarsaparilla. Poplars, elms, laurels, oaks, hornbeams, beeches, chestnuts, willows, planes, figs, buckthorns, walnuts, maples, spindle-trees, and breadfruits formed dense groves, in which evergreens predominated. Nettle-trees (Celtis), several kinds of Banksia, and gum-trees (Eucalyptus), now found only in Australia, were present, as well as giant cacti, like those of New Mexico. This forest extended over Europe from Lombardy as far north as the valley of the Thames.

The Miocene forests at Bovey Tracey, in Devonshire, and in Ireland and the Hebrides, differed from the above principally in the absence of the tropical forms, and the increase in the number of sequoias, tulip-trees, and other North American types. In France, Germany, and Switzerland, however, they still continued tropical in character, with abundance of camphors, cinnamons, and laurels. The vegetation of Central and Southern France in the Pliocene age is intermediate in character between the wonderful evergreen flora of the Miocene and that now living in Southern Europe. The forests in the neighbourhood of Lyons contained bamboos, liquidambers, tulip-trees, maples, magnolias, poplars, and willows, and five kinds of laurels, and were mainly evergreen. These flourished at a height of 200 metres above the sea. In Auvergne, at a height of 700 metres, it was composed of deciduous trees, maples, alders, poplars, willows, elms, and ashes, and at 1200 metres of pines, one of which, *Abies pinsapo*, grows in Andalusia at altitudes ranging from 1100 to 1200 metres. These three forest zones represent the distribution of the forests in Middle and Northern Europe at low altitudes. Beyond the zone of evergreens was that of deciduous trees, and beyond that pines. The cinnamon trees and sabal palms, in the Miocene growing as far to the north as the Lower Rhine, in the early Pliocene did not grow further to the north than the plains of Lombardy. In the Pleistocene age the face of Britain was covered with the ordinary forests of the temperate zone in Europe, among which we may note the spruce, not now indigenous. As the cold increased the Arctic plants crept down to the level of the sea, such, for example, as the *Salix polaris*, or Arctic willow, found in the Preglacial deposits of Norfolk. As the cold diminished and the climate became what it is now, they retired northwards and to the colder regions at high altitudes where they now live. Owing to climatal and geographical changes which

took place in the Tertiary period the flora of the northern hemisphere in the Eocene, Miocene, and Pliocene ages became scattered over the surface of the earth, and some members of it living side by side in Europe, such as the Sequoia and the Eucalyptus, were banished to regio remote as North America and Australia.

2. *The Animals.*—While the chang in th etable kingdom recorded in the rocks are few an unimportant those in the animal kingdom have been great, and more especially in the more highly organized forms. It is a significant fact that the only fossil identified with certainty in the Archæan, or the lowest sedimentary rocks, is the Eozoon, a foraminifer belonging to one of the simplest and lowest members of the animal kingdom. In the succeeding Cambrian strata all the invertebrate divisions, with the exception of the Cœlenterata, are represented—the Spongida by *Protospongia fenestrata*, the Echinodermata by crinoids (Dendrocrinus) and starfishes (Palæasterina), the Brachiopoda by *Lingulella Davisii*, *Orthis Carausii*, &c.; the Lamellibranchs by *Ctenodonta cambrensis*, &c.; the Cephalopoda by Orthoceras, the Heteropoda by Bellerophon, the Pteropoda by *Theca corrugata*, &c.; the Crustacea by Trilobites, and the Vermes by the Annelids. While the only living genera in the Cambrian age belong to the Brachiopoda, it is important to note that the principal invertebrate divisions were as clearly defined from each other as at the present day. In the Arenig strata, or the lowest of the Silurian, the Branchio-gasteropoda, now so abundant, appear, Pleurotomaria, Euomphalus, and two others, as well as the Cœlenterata; and in the upper division the Vertebrates—the sharks being represented by Onchus and Ctenacanthus, and the ganoids by Pteraspis and Asterolepis. The Devonian and Carboniferous seas and lakes swarmed with fishes of both these divisions, but there is no certain proof of the existence of the teleostean fishes now so abundant. In the former age the first Insecta appear, uniting the wings of the Neuroptera with a stridulatory apparatus like that of a cricket, and in tl latter the Myriapoda, beetles, scorpions, and gigantic spiders. In the latter, too, we have the first air-breathing mollusc (*Pupa vetusta*). The Carboniferous ganoids, Megalichthys, Ctenodus, &c., were possessed of amphibian characters, and the Amphibia themselves occur in the Carboniferous rocks, the Labyrinthodon, and others, and constitute the most important forms found in the Primary Palæozoic group of rocks. With the exception of the Foraminifera no Primary species is known in existing nature, and by far the larger number of genera became extinct in the interval between the Primary and Secondary periods.

At the beginning of the Secondary period, in the Trias, the Reptilia are represented by extinct orders of very remarkable organization—the Dicynodontia, with a head and beak like a turtle, with two large canines in the upper jaws, and a *sacrum* composed of six vertebræ; the Theriodontia, with teeth divided into incisors, canines, and molars, and the extremities composed of the same number of digits as in the Mammalia. The Dinosauria, or gigantic land reptiles (Cheirotherium, &c.), which were the masters of the earth until the end of the Secondary period, combining the massive marrow-containing long bones of the mammal with the structure of the limbs of a fœtal bird, and being divided into two types—the flesh-eating or Megalosaurus, and the herbivorous or the Iguanodon. In the Rhœtic strata the modification of the reptilian structure for flight is seen in the Pterodactyle, possessing leathery wings like the bat, and hollow bones for the reception of *hot* air like the birds of flight, while the Ichthyosaurus and Plesiosaurus show an equal adaptation of the reptilian structure for living in the sea—in the amphicœlian vertebræ, and in the possession of paddles. Existing orders were present. The Telerpeton from the Rhœtic strata of Elgin is a Lacertilian. Among the Crocodilia the Teleosaurus ranges from the Rhœtic to the Cretaceous formations, while the true Crocodilus, with Opisthocœlian vertebræ, appears for the first time in the Cretaceous rocks. The Chelonia, or turtles, appear in the Oolitic period. From this strange development of Reptilia in the air, in the sea, and on the land the Secondary is truly called the "Age of Reptiles." The first birds appear in the Oolitic period (*Archæopteryx macroura*), intermediate in structure between birds and reptiles, possessing feathers and the greater part of the osseous framework of the one, and the teeth and long tail of the other. In the Cretaceous age in America the fossil birds (Ichthyornis, &c.) present a nearer approximation to living birds in possessing a true avian tail, although the reptilian teeth are still present. These two forms are to be looked upon as "missing links" between the avian and reptilian orders. The Mammalia, too, occur in the Secondary rocks in the Old and New Worlds—in the Triassic strata of South Africa, the Trilytodon; in the Rhœtic formation, the Microlestes, &c.; in the Lower Oolites, the Phascolotherium, &c.; and in the Purbeck strata, the Plagiaulax, &c. They were all small animals, not larger than hares, and belong either to a more generalized type of mammal than any now alive, or to the marsupials. Among the fishes we must also note the ganoid genus Ceratodus of the Rhœtic strata as being now found in the rivers of Queensland, and that the teleostean soft-scaled fishes first appear in the Cretaceous rocks, and along with them the sharks (Otodus, &c.) with sharp teeth, while the sharks with crushing teeth, belonging to the Cestraciontidæ, living in the European seas through the later Primary and Secondary ages, disappeared from the seas of the Old World before the beginning of the Tertiary period. Among the characteristic Secondary Mollusca the Ammonites and their allies, and tl Belemnites, are the most important, and from the Liassic to the Cretaceous age the genus Trigonia, now restricted to the Australian seas, abounded in Europe.

The Tertiary—or the period when the placental mammals took possession of the land, flew in the air as bats, and swam in the sea as Cetacea and Sirenia—is characterized by their gradual approximation to living forms, as we have seen, from the Eocene down to the present time. The marsupials (Didelphys), however, did not disappear from Europe till the close of the Lower Miocene age, and most of the Eocene carnivores present traces of a marsupial ancestry. The armour-clad ganoids, too, of the Secondary are represented in Europe in the Eocene and Lower Miocene ages by the Lepidosteus now found in the rivers of North America. True birds in the Eocene age took possession of the realm of the air, and in the sea the flesh-eating Siphonostomata, which begin to appear in the Cretaceous strata, are abundant, and take the place of the Secondary Cephalopoda, and hold it in the present seas. The history of the order Primates may indeed be taken to be typical of the kind of progressive appearance of mammalian forms which runs through the Tertiary period. The lowest family appears in the Eocene (Necrolemur, &c.); the second family, the Simiadæ, in the Miocene (Dryopithecus, &c.); while the third, Anthropidæ (Man), appears on the earth in the Pleistocene age. Thus the geological record of life, which begins with the Eozoon, runs through the higher forms until it ends with Man, the highest of all:—

"The herald of a higher race,
Or of himself in higher place,
If so he type this work of time
Within himself from more to more."

(Nicholson, "Palæontology," Etheridge, "Addresses," *Quart. Jour. Geol. Soc. Lond.*, 1881–82; Gaudry, "Les Enchainements du Monde Animal, Mammifères Tertiaires," "Fossiles Primaires;" Owen, "Fossil Mammals," "Palæontology.")

E. Applied Geology.—The application of the science of geology to the arts is most varied and important, and is

ultimately based upon an accurate geological map showing the surface and sections, and the structure of the country below the surface. The maps are made by carefully noting the surface indications, and more particularly the dip of the rock. (See Map and Plates II. to VI.)

The sections are constructed with reference either to *ordnance datum* or to high-water mark, and show the run of the rocks beneath the surface, either proved by deep sinkings or borings in the line of section, or inferred from observations of the same rocks taken somewhere else. These maps and sections are of the greatest service to the civil engineer. In choosing the position of a stone quarry, for example, the dip of the rock and the intersections of the lines of joints, are points upon which turn success or failure. In planning railway cuttings, canals, and tunnels in districts where the rocks are highly inclined and consist of pervious and impervious strata, the direction of the dip must be looked to. If they be placed on the side of the valley *towards* which the rocks dip they will be liable to slips, while if they be placed on the side *from* which the rocks dip they are generally safe. The neglect of this simple rule has frequently led to disastrous results. The successful carrying out of the Channel Tunnel scheme depends upon the gentle inclination and continuity of the chalk underneath the channel between England and France, two points which have been most satisfactorily proved, as well as the further point that the rocks through which the tunnel is to be made are practically impervious.

Nor is the light thrown by geology on questions of water-supply less important. The rocks may be classified, according to their capacity for storing water, into three groups:—1. Those which are always pervious and water-bearing, such as the sands and sandstones; 2, the impervious, through which the water cannot pass swiftly, the clays, shales, schists, and compact igneous crystalline and fragmento-crystalline rocks; and 3, the doubtful class, composed of rocks in which the available water is stored up in holes and crannies, and does not percolate between the particles of the rock sufficiently swiftly to be available for practical purposes. The success of a well in these rocks depends upon the accident of its tapping the water-bearing cavities. The various kinds of limestone, and the chalk which is so important a source of water-supply, belong to the last division. The water-line in the rocks slopes gently upwards from the bed of the stream or high-water mark, conforming roughly to the surface contour. This slope of water is termed *a water gradient*. The amount of water obtainable from a rock at any given point will depend not merely on its porosity, nor merely on the area drawn upon by the well, but upon the amount of rainfall from which the rocks derive their water. This varies from 178 inches per annum at Seathwaite in Cumberland, to 18 inches on the east coast of England. The *water-parting* is the line of elevation dividing one drainage area from another, and the space included by it is the *area of catchment*. The principal water-bearing rocks in Britain are the millstone grits and coal-measure sandstones, as yet scarcely drawn upon, the sandstones of the Permian and the Trias, the Lower Greensand and the Tertiary sands of Thanet and Bagshot, which supply vast quantities of water. In the doubtful class the Carboniferous limestone, the Oolitic limestones, and the Chalk generally afford a large supply. A well made through imper[illegible]d which the water rises surfacewards under the pressure of the head of water in the pervious strata, elsewhere at a higher level, is termed *Artesian* (Artois).

Geology also renders important service to the mining engineer. It not only defines for the coal-miner the area of the coal-fields at the surface, but it shows him where coal may be looked for in areas buried beneath the rocks, and indicates the depth at which they may be expected. In working the coal seams it points out how to deal with the various kinds of faults and disturbances affecting the continuity of the seam. To the metal-miner it indicates the areas where he may look for metal; for tin, gold, and platinum, the altered, faulted, and broken Primary rocks and the granites; for lead, copper, and iron, not merely the above but also the Secondary rocks. To the farmer also it points out the source of the subsoil upon which the success of his operations largely depends, and enables him to mix the soils to the great advantage of his crops. It is of importance in house-building, draining, and sanitary matters generally. In conclusion, it may be said that it has a practical bearing upon all pursuits which have to do directly with the surface of the earth.

GE'OMANCY, among the ancients, a kind of divination which Polydore Vergil describes as being performed by means of clefts or chinks made in the ground, and first invented by the Persian magi. The Greeks performed the ceremony of geomancy by means of a number of little points or dots made on paper at random. According to the different lines and figures presented by those points they formed a judgment of futurity, and decided any question proposed.

GEOMETRICAL PERIOD, a period of Gothic Architecture.

GEOMETRICAL PROGRESSION is a progression by means of a common factor, as contradistinguished from *arithmetical progression*, or progression by a common difference. Thus while 1, 3, 5, 7, 9 are in arithmetical progression, the difference being 2 between any two contiguous terms, 1, 3, 9, 27, 81, are in geometrical progression, the common factor being 3; that is to say, though the difference varies, the *ratio* between any pair of contiguous terms is the same.

To find the sum of any number of terms in geometrical progression the following formula is used:—

$$s = a\left(\frac{r^n - 1}{r - 1}\right),$$

where s is the sum required, a the first term of the series, n the number of terms, and r the common factor. It is evident that by help of this formula, any three of these four quantities being given, the fourth can be readily found.

GEOM'ETRY (Gr. *geometria*, or earth-measurement), the science which investigates the relations existing between parts of space, whether linear, superficial, or solid. But, at the same time, the most common meaning of the word implies that the investigation is to take place under restrictions as to the instruments which may be employed.

Among the Chinese the Jesuit missionaries found very little knowledge of the properties of space; a few rules for mensuration and the famous property of the right-angled triangle being all that they could ascertain. The Hindus produce a much larger body of knowledge, but of uncertain date.

Of the Babylonian and of the Egyptian geometry we have no remains whatever, though each nation has been often said to have invented the science. In the Jewish writings there is no trace of any knowledge of geometry. So that, allowing the Greeks to have received the merest rudiments either from Egypt or India, or any other country, it is impossible to name any quarter from which we [illegible] ith any probability imagine them to have received a deductive system, to ever so small an extent.

Thales and Pythagoras (about 600 B.C.) founded the earliest schools of geometry. The latter is said to have sacrificed a hecatomb when he discovered the property of a right-angled triangle.

According to Proclus, Pythagoras was the first who gave geometry the form of a science. Plato was the next great advancer of the science. To him succeeded various others; after whom came Euclid. Demonstration had been

introduced about the time, perhaps by the instrumentality, of Pythagoras; pure geometry had been restricted to the right line and circle, but by whom is not at all known; the geometrical ANALYSIS and the study of the CONIC SECTIONS, as also the consideration of the problems of the duplication of the cube, the finding of two mean proportionals, and the trisection of the angle, had been cultivated by the school of Plato; the quadrature of a certain circular space had been attained, and the general problem suggested and attempted by Hippocrates and others; incommensurables had been written on; a curve of double curvature had been imagined and used by Archytas; writings existed both on the elements and on conic sections, loci, and detached subjects. Euclid took up the science at this point.

It is not known where Euclid was born. He opened a school of mathematics at Alexandria, in the reign of Ptolemy, the son of Lagus (323–283 B.C.), from which school came Eratosthenes, Archimedes, Apollonius, Ptolemy, the Theons, &c., so that from and after Euclid the history of the school of Alexandria is that of Greek geometry. Besides the famous "Elements," Euclid wrote, or is supposed to have written, a treatise on Fallacies, preparatory to geometrical reasoning, four books of Conic Sections, three on Porisms, &c. These works are now lost; those which follow all exist, and are contained in Gregory's edition:—

1. "A Treatise on Optics and Catoptrics." Proceeding on the supposition that rays of light are carried *from the eye to the object*, the first of these books demonstrates some relations of apparent magnitude, and shows how to measure an unknown height by the well-known law of reflected light. In the second, an imperfect theory of convex and concave mirrors is given.

2. "On Astronomical Appearances," containing a geometrical doctrine of the sphere, which, though probably much corrupted by time, is undoubtedly Euclid's.

3. "The Division of the Scale and Introduction to Harmony," at that time held to be a part of mathematics. These are two treatises of which undoubtedly only the first belongs to Euclid. See EUCLID.

4. "A Book of Data." This is considered the most valuable specimen which we have left of the rudiments of the geometrical analysis of the Greeks. Before a result can be found it should be known whether the given hypotheses are sufficient to determine it. The application of algebra settles both points, that is, ascertains whether one or more definite results can be determined, and determines them. But in geometry it is possible to propose a question which is really indeterminate, and in a determinate form, while at the same time the methods of geometry which give one answer may not give the means of ascertaining whether the answer thus obtained is the only one.

5. "The Elements" (of Geometry). For a long time writers hardly considered it necessary to state whose Elements they referred to, since a certain book of the Elements always signified that book of Euclid; and it was customary in England to call each book an Element; thus in Billingsley's old translation the sixth book is called the *sixth Element.*

The reason why "The Elements" have maintained their ground is not their extreme precision in the statement of what they demand; for it frequently happens that a result is appealed to as self-evident which is not to be found in the expressed axioms. Neither does their fame arise from their never assuming what might be proved; for in the very definitions we find it asserted that the diameter of a circle bisects the figure, which might be readily proved from the axioms. Neither is it the complete freedom from redundancy, nor the perfection of the arrangement; for book i. prop. 4, which is very much out of place, considering that it is never wanted in the first book, is, in point of fact, proved again (though not expressed) in prop. 19. Neither is it the manner in which our ideas of magnitude are rendered complete as well as definite; for instance, book iii. prop. 20, is incomplete with Euclid's definition and use of the term angle; nor with that term as used by him can the 21st proposition of that book be fully demonstrated without the help of the subsequent 22nd. In fact, "The Elements" abound in defects, which, if we may so speak, are clearly seen by the light of their excellences; the high standard of accuracy which they inculcate in general, the positive and explicit statement which they make upon all real and important assumptions, the natural character of the arrangement, the complete and perfect absence of false conclusion or fallacious reasoning, and the judicious choice of the demonstrations, considered with reference to the wants of the beginner, are the causes of the universal celebrity which this book has enjoyed.

There are thirteen books certainly written by Euclid, and two more (the fourteenth and fifteenth) which are supposed to have been added by Hypsicles of Alexandria (about 170).

The writings of Euclid continued to be the geometrical standard as long as the Greek language was cultivated. The Romans never made any progress in mathematical learning, nor did the Arabs, though many of the works of [illegible]ek [illegible] slated, and Euclid [illegible] the [illegible] There are several Arabic versions, one of which, that of Nasir Eddin, was printed at the Mediceum press at Rome in 1594. The earliest printed edition of "The Elements" is that of Ratdolt (Venice, 1482), Latin. The earliest Greek one is that of Grynæus (Basel, 1533). The earliest edition of all Euclid's work is the Latin version of Zamberti (Venice, 1505). The manifold beauties of "The Elements" of Euclid secured their universal reception, and it was not long before geometricians began to extend their results. It became frequent to attempt the restitution of a lost book by the description given of it by Pappus or others; and, from Vieta to Robert Simson, a long list of names might be collected of those who have endeavoured to repair the losses of time.

The application of algebra to geometry, of which some instances had been given by Bombelli, and many more by Vieta, grew into a science (Géométrie Analytique) in the hand of Descartes (1596–1650). It drew the attention of mathematicians completely away from the methods of the ancient geometry, and, considering the latter as a method of discovery, the change was very much for the better. But the close and grasping character of the ancient reasoning did not accompany that of the new method: algebra was rather a half-understood art than a science, and all who valued strictness of demonstration adhered as closely as possible to the ancient geometry.

The methods of algebra, so far as expressions of the first and second degrees are concerned, apply with great facility to many large classes of questions connected with straight lines, circles, and other sections of the cone. Practical facility was gained by them, frequently at the expense of reasoning: the time came when a new Descartes showed how to return to geometrical construction with means superior to those of algebra in many matters connected with practice. This was Monge, the inventor of *descriptive geometry.* The science of perspective and many other applications of geometry to the arts had previously required isolated methods of obtaining lines, angles, or areas, described under laws not readily admitting of the application of algebra, and its consequence, the construction of tables. The descriptive geometry is a systematized form of the method by which a ground-plan and an elevation are made to give the form and dimensions of a building. If, for instance, we know that a picture hangs a certain distance measured perpendicularly from a front window and a certain distance measured vertically from

the floor, we know the position of that picture. We have, in fact, projected the picture on to the two planes at right angles to each other, formed by the front of the house and its floor. In geometrical language projections of a point upon two planes at right angles to one another being given, the position of the point itself is given. From this it is possible, knowing the projections of any solid figure upon two such planes, to lay down on either of those planes a figure similar and equal to any plane section of the solid. In the case where the section is a curve, it is constructed by laying down a large number of consecutive contiguous points. The methods by which such an object is to be attained were generalized and simplified by Monge, whose "Géométrie Descriptive" is one of the most elegant and lucid elementary works in existence.

The methods of descriptive geometry recalled the attention of geometricians to the properties of projections in general, of which such only had been particularly noticed as could be applied in the arts of design or in the investigation of primary properties of the conic sections. From the time of Monge to the present this subject has been cultivated with a vigour which has produced most remarkable results, and promises more. Pure geometry has made no advance since the time of the Greeks which gives greater help to its means of invention than that which the labours of what we must call the school of Monge have effected. In the higher geometry of the present day considerable strides have been made, first, by the method of Sir William R. Hamilton, of Dublin, called QUATERNIONS, and its extension into bi-quaternions by Professor W. K. Clifford, Lobatschewsky, Riemann, and others. Indeed, Clifford devoted much attention to the philosophy of geometry, with most luminous results. Examining the truths underlying a demonstration of Euclid, he proceeds to point out the fundamental postulates involved in the assumption.* These are that of continuity—according to which two adjacent portions of space have the same boundary; that of elementary flatness—according to which the "aggregate of directions" or the complete solid angle "round one point is exactly to that round another;" that of superposition—according to which space has all its parts exactly alike; that of similarity—by which any figure may be magnified or diminished without altering its shape. This last postulate includes the theory of parallels proceeding on the basis of Euclid's twelfth axiom; but of this axiom there has never been given a satisfactory proof. To Lobatschewsky occurred the idea of doing without it; and he made a supposition which alters the theorem that the three angles of a triangle are equal to two right angles, into a theorem that they are less than two right angles. On this he built up a consistent theory, and his plane geometry becomes identical with the geometry of a surface, the curvature of which is everywhere negative and constant. Of such a surface, we have as an example the inner surface of a spherical hollow. But while this train of ideas had great influence over Clifford, that which most affected his investigations was the hypothesis—alternate from that of Lobatschewsky—of the constant positive curvature of space. Of a surface of constant positive curvature we have as an example the surface of a sphere. To the working out of the consequences of this hypothesis many of his papers refer, and these are they which are more peculiarly original: they form one of the most striking memorials of his power in the exercise of his genius.

GEOPH'ILA, a genus of plants belonging to the order RUBIACEÆ. The species are creeping herbaceous plants, with stalked cordate leaves like those of a violet. *Geophila reniformis* is a native of moist shady places in the hotter parts of America. The root of this plant is emetic, and may be used with advantage as a substitute for ipecacuanha.

GEORGE (LOUIS) I., King of England, and Electoral Duke of Hanover, was the son of the Electress Sophia of Hanover, who was chosen by the English Parliament, in 1701, to follow Queen Anne in the succession. By the treaty of Union with Scotland in 1706 the succession to the monarchy of the United Kingdom was again assigned to the Electress Sophia. Queen Anne died on the 1st of August, 1714 (the electress had died some six months before), and George I. therefore ascended the British throne. He was born on the 28th of May, 1660. In 1682 he married Sophia Dorothea, daughter of the Duke of Zelle, and succeeded his father, Duke Ernest, in the electorate, in 1698. Duke Ernest was the first Elector of Hanover, and the elevation of the duchy into an electorate was much disputed by the other eight electors, who disapproved of the emperor's action in the matter. George was not recognized fully as elector until 1705. The title gave a vote in the election of the Emperor of Germany, and therefore was of value for the influential position it conferred. In 1700 he aided the Duke of Holstein against Frederick IV. of Denmark, and during the war between England and France which commenced in 1702 he steadily supported the former, although he would not consent to sacrifice what he conceived to be his duty as a German prince when the English ministry prepared their original measures for the peace of Utrecht. The new king arrived with his son at Greenwich on the 28th of September. Already the Tories had been turned out, and a Whig ministry, including Viscount Townshend and Walpole (afterwards Sir Robert), formed by the lords justices. The impeachment of Bolingbroke, Oxford, and others, was determined upon in a new Parliament in January, 1715; but these measures did not prevent the opponents of the dynasty from continuing their machinations. A serious rebellion in Scotland broke out in 1715, but was quickly suppressed. The Parliament then repealed the Triennial Act, and extended the duration of Parliament to seven years. The treaty of Triple Alliance, concluded by George I. with France and Holland in 1717, was a defensive measure against Charles XII.; but the war with him was unimportant, and ended with his death in 1718. Meantime, in April, 1717, the Whig ministry was broken up; and Lord Stanhope and the Earl of Sunderland obtained the chief power in the room of Viscount Townshend and Walpole. The intrigues of Cardinal Alberoni now led to a war with Spain, and to the formation of the quadruple alliance of Great Britain, France, the emperor, and Holland, against Spain. In June, 1719, the second Jacobite rebellion was put down; and the same year peace with Spain was concluded. The reconciliation, in April, 1720, of the king and his son, who had been long at variance, led to the reintroduction of Walpole into the ministry, and eventually, on the overthrow of the Stanhope and Sunderland administration, in consequence of the South Sea scheme exposures, to his premiership, which lasted for twenty-one years; during which he had to deal with the consequences of the entanglement of the country in continental politics through the Hanoverian connection, and which at length led to a war between the King of Spain and the emperor, engaged by the treaty of Vienna, 30th April, 1725, on the one side, and England, France, and Prussia, combined in accordance with the treaty of Hanover, 4th September, 1725, on the other. Preliminary articles of general pacification were signed at Paris, 31st May, 1727. George died at Osnabrück, 11th of June following. By his queen, who died 2nd November, 1726, at the Castle of Ahlden, in Hanover, where she had been immured since 1694 on a charge of an intrigue with Count Königsmark, George I. had one son, George, who succeeded him, and a daughter, Sophia Dorothea, who married King Frederick-William I. of Prussia in 1706. The king is said to have made a left-handed marriage with Madame Schulenberg (the "Maypole"), whom

he created Duchess of Kendal in 1719. His other chief mistress was the wife of Baron Kielmansegge, created Countess of Darlington in 1722. She was as grossly fat as Schulenberg was painfully lean. There seems some reasonable supposition that she was not his mistress, but an illegitimate half-sister. All these people were handsomely pensioned, Queen of Prussia and all. Extensive changes were made in the laws during this reign. The Riot Act was passed, 1 George I.; and an Act for disarming the Scottish Highlands, 11 George I. The first sinking fund on a great scale was established by Walpole, 3 George I.; and although the principal was not reduced, but remained at about £52,000,000, the interest of the debt was decreased from £3,350,000 to £2,217,000.

GEORGE (AUGUSTUS) II., King of Great Britain, and Electoral Duke of Hanover (not yet made into a kingdom), the only son of George I., was born at Hanover, 30th October, 1683. On the 22nd of August, 1705, he married Wilhelmina Caroline, daughter of John Frederick, margrave of Bradenburg Anspach. On the 9th of November, 1706, he was created Duke of Cambridge. He distinguished himself at the battle of Oudenarde, 11th July, 1708, when Marlborough defeated the French. On the accession of his father to the British throne he was created Prince of Wales, and immediately became the centre of various political intrigues. A quarrel broke out between the prince and the King towards the close of 1717, the causes of which are not clearly known, but which led to much public discussion and scandal. The prince and princess were sent away from St. James's, and their children detained by the king's order, which was supported by the opinion of the judges. The parents in consequence declined to pay for the education of their children out of the £100,000 a year which they received.

George II. succeeded his father on the 11th of June, 1727. Through the influence of his queen, who ruled her rather foolish husband without his suspecting it, Walpole was continued in office. The war with Spain was terminated by the treaty of Seville, 9th November, 1729. Ten years later it broke out again, through the alleged interference of that power with the freedom of English commerce. The death of the Emperor Charles VI. in 1740 led to a general European war. Great Britain supported the Pragmatic Sanction, by which the emperor's eldest daughter, Maria Theresa, queen of Hungary, succeeded to the Austrian dominions, while France and Spain maintained the claims of Charles-Albert, the elector of Bavaria, who two years later was elected emperor, under the title of Charles VII. Walpole's pacific policy now became distasteful, and his most powerful supporter, the queen, died in 1737. A family quarrel between George II. and his son broke out in 1739, and the latter formed a party, avowedly to overthrow the premier. A new Parliament met in December, 1741, and Walpole found it necessary to retire in the January following, when he was created Earl of Orford. His rival Pulteney succeeded. A reconciliation took place between the king and prince, but the latter was soon once more in open opposition to the court and ministry. The war on the Continent was at this time prosecuted with vigour by the English and their allies. On the 26th of June, 1743, the French were defeated at Dettingen, and George II., who was present, behaved with distinguished courage. Inactivity and reverses followed. The war party in the ministry, under Lord Grenville, was expelled, and a new ministry was formed, of which Pelham, brother to the Duke of Newcastle, was first lord of the Treasury, and Pitt (afterwards the Earl of Chatham) was a supporter. But the king's former policy was still maintained; and on the 30th of April, 1745, the allies were defeated by the French at Fontenoy. The same year broke out the great Scottish rebellion. The king's troops were defeated at Prestonpans and Falkirk, and the Pretender reached Derby; but the king's second son, the Duke of Cumberland, defeated him at Culloden, 16th April, 1746. Two years later the treaty of Aix-la Chapelle brought the continental war to a close, after some brilliant naval successes on the part of Great Britain. War again broke out with France in June, 1755. Pitt became premier in December, but was succeeded in June, 1757, by the Earl of Waldegrave, with Fox as secretary of state. Pitt again succeeded them within two or three weeks, in conjunction with the Duke of Newcastle and Fox, and by that powerful coalition affairs were conducted until the close of the reign. The war now became general. Great Britain had allied herself with Prussia in January, 1756, and France with Austria in May of the same year. The enemy were driven out of Bremen and Verdun in Germany in 1758; Senegal and Goree on the African coast were taken from the French soon afterwards; the victory of Minden was gained on the 1st of August, 1759; the French navy was almost annihilated; the conquest of Canada was nearly completed by Wolfe's victory on the heights of Abraham, 13th September, 1759; and lastly, Clive in India, having regained Calcutta, 2nd January, 1757, and overthrown the subahdar of Bengal at Plassy, 23rd June, was rapidly expelling the French from India, when George II. suddenly expired at Kensington Palace on the 25th of October, 1760. His children by his queen were three sons and five daughters, of whom the most remarkable were Frederick, prince of Wales, who had died before his father, in 1751 (and whose son George succeeded George II. on the throne), and William-Augustus, duke of Cumberland, the victor at Culloden. George II., as well as his father, had a succession of mistresses; the two principal were Mrs. Howard and the Countess of Yarmouth, who was the last individual raised to the peerage in England by so scandalous an abuse of the honours of the state. Among the legislative Acts of the reign may be mentioned those for causing all law proceedings in the English courts of justice and in the Scotch Court of Exchequer to be carried on in the English language, 4 Geo. II.; and this was extended to Wales two years later; allowing counsel to persons tried for treason, 20 Geo. II.; the use of the new style, 24 Geo. II.; the foundation of the British Museum by the purchase of the Sloane Museum and Harleian MSS., 26 Geo. II.; and the Marriage Act, 26 Geo. II. The national debt was increased during this reign, and amounted at the close of the Seven Years' War in 1763 to nearly £139,000,000, and the interest to above £4,850,000.

GEORGE (WILLIAM-FREDERICK) III., King of England and Hanover (Elector of Hanover till 1815), eldest son of Frederick-Louis, prince of Wales, and grandson of George II., was born 4th June, 1738. His mother was Augusta, daughter of Frederick II., duke of Saxe-Gotha, who was married to the prince 25th April, 1736, and had by him four other sons and four daughters. After the death of the prince George-William was himself created Prince of Wales. During his youth his mother kept him in great seclusion. His education was made the subject of much political intrigue and dissension. Eventually Lord Harcourt and Dr. Hayter gave place in 1752 to Lord Waldegrave and Dr. Thomas, then bishop of Peterborough, as the governor and tutor of the prince. The instigator of these changes is understood to have been Lord Bute. On the whole it appears the young prince was educated virtuously, but within very narrow limits. He ascended the throne on the death of his grandfather, the 25th October, 1760. On the 8th of September following he married Charlotte-Sophia, second daughter of Charles Lewis Frederick, duke of Mecklenburg-Strelitz. Lord Bute was soon introduced into the ministry (in 1761), in order, it is supposed, to aid the king in bringing the war to a close. Pitt resigned in October, 1761, the cabinet refusing to declare war against Spain, which, however, broke out in January, 1762. The resignation of the Duke of Newcastle made

way for the elevation of Lord Bute to the premiership in June, 1762, an event soon followed by a general peace. Lord Bute resigned on the 8th April, 1763, and was succeeded by Mr. Grenville, whose ministry was soon engaged in the famous contest with John Wilkes. The king became ill in April, 1764, and on his recovery in a few weeks he proposed that a bill should be brought in empowering him to appoint the queen or any other member of the royal family to act, in case of his demise, as regent during the minority of his successor. By Lord Bute's manœuvres the ministers were placed in opposition to the desires of the king, and were defeated in Parliament on the Regency Bill which was subsequently passed. On the 22nd of March, 1765, certain stamp duties were imposed upon the American colonies; but the king having found himself strong enough to dismiss the Grenville ministry, the new one formed by the Marquis of Rockingham, in July, 1765, repealed the Act in 1766. This ministry soon fell, and the Pitt administration succeeded in June, 1766. Pitt was created Earl of Chatham; and on the 2nd of June, 1767, Mr. T. Townshend, the chancellor of the exchequer, brought forward that renewed measure of American taxation which eventually led to American independence. Mr. Townshend died suddenly, 4th September, and was succeeded by Lord North as chancellor of the exchequer, with the Duke of Grafton as first lord of the Treasury. Lord Chatham resigned on the 15th of October, 1768, and the Duke of Grafton, apparently unable to endure the severe attacks of Junius, which commenced early in 1769, suddenly resigned 28th January, 1770. Lord North then became premier, and sought to allay the excitement in English America by repealing the obnoxious duties, with the exception of the tax on tea, which was retained to assert the right of taxation. In 1771 the newspaper press, after a contest of two months, successfully asserted its right to report the parliamentary debates. Some marriages in the royal family distasteful to the king led to the passing of the Royal Marriage Bill. The disturbances in America broke out afresh in 1773. The *Gaspee* schooner was attacked and burnt at Providence, in Rhode Island, in June; and the destruction of the tea by the mob at Boston took place in December. The first blood was spilt in a skirmish at Lexington, 19th of April, 1775, and on the 4th of July, 1776, was issued the American Declaration of Independence. Burgoyne surrendered at Saratoga on 16th October, 1777. The following year France acknowledged the American independence. The surrender of Lord Cornwallis at Yorktown, 19th October, 1781, in effect terminated the struggle. These events led to a war with France in 1778, with Spain in 1779, and with Holland in 1780. The same year Russia, Denmark, and Sweden combined for the maintenance of an armed neutrality, which was intended in fact to prevent Great Britain from enforcing the usual rights of belligerents. At home the Gordon or Protestant riots broke out, and London was nearly a week in the hands of a devastating mob. In Ireland 50,000 or 60,000 armed volunteers assumed a threatening aspect. At last Lord North and his colleagues resigned, 20th March, 1782, and were succeeded by the Marquis of Rockingham, who died within three months. Lord Shelburne then assumed the direction of affairs, upon which Fox and his friends resigned. Pitt (the younger) became chancellor of the exchequer. The American independence was acknowledged by Great Britain at Paris, 30th November, 1782, when preliminaries of peace were signed with America, France, and Spain. Peace with Holland was concluded the following year. About the same time the independence of the Irish Parliament was reluctantly acknowledged. The famous coalition between Lord North and Fox had in the meantime overthrown Lord Shelburne's ministry, but had itself been speedily ejected from power in favour of a Pitt administration, which, after a very severe struggle, firmly established itself. The subject of parliamentary reform now agitated the country. In November, 1788, the king was attacked by what was admitted to be insanity, and did not recover until March following. The history of the remainder of his reign is chiefly that of the share borne by England in the wars which grew out of the French Revolution of 1789. Mr. Pitt was at first opposed to the war with France, but his party, the court, a large section of the Whigs, headed by Burke, and a great portion of the country, urged it on. The general course of the war, down to its final conclusion at Waterloo in 1815, will be found described in the article NAPOLEON, to which the reader is referred. The king was attacked by the mob on his way to the House of Lords, 29th October, 1795. In 1800 the Union of Great Britain and Ireland was effected, and Pitt retired, as the king refused to consent to the removal of the Catholic disabilities, a measure to which the minister considered himself pledged. The administration of Addington (afterwards Lord Sidmouth) succeeded. On the 25th March, 1802, peace was concluded at Amiens, but lasted only a few months. The chief political events of the succeeding years of George III.'s reign were the recurrence of the king's malady in 1801 and 1804; the restoration of Pitt to power, May, 1804; his death on the 23rd of January, 1806, and the consequent formation of a ministry under Fox and Lord Grenville; the death of Fox, 13th September; the dissolution of the Grenville administration in March, 1807, on the question of Roman Catholic relief; the formation of a new cabinet under the Duke of Portland and Mr. Perceval; the decided insanity of the king, October, 1810, and the appointment of the Prince of Wales as regent, February, 1811; the assassination of Mr. Perceval, 11th May, 1812; and the appointment of the Earl of Liverpool as premier, whose ministry lasted till the end of the reign. By the Congress of Vienna settling the affairs of Europe on the downfall of Napoleon in 1815 Hanover was raised to a kingdom from its previous condition of an electoral duchy. George III. of England was therefore the first king of Hanover. The king died at Windsor Castle, 29th January, 1820. He had been entirely blind for some years before his death. By his queen Charlotte, who died at Kew 17th November, 1818, George III. had nine sons and six daughters. During his reign the financial operations of the country assumed a gigantic magnitude. The revenue from taxation was increased to about £53,000,000, and in 1815 had amounted to above £72,000,000. The national debt was increased from £108,000,000 to above £800,000,000. Among the immense mass of legislation of the reign may be noticed Fox's Libel Law, 1792, declaring juries to be judges of the law as well as of the fact; the abolition of the slave trade, 1807; Romilly's Acts of 1811 and 1818 for the amelioration of the criminal law; the Unitarian Relief Act of 1813; and the Six Acts of 1819 for the suppression of blasphemy and sedition.

GEORGE (AUGUSTUS FREDERICK) IV., King of England and Hanover, son of George III., was born 12th August, 1762, and was on the 17th created Prince of Wales and Earl of Chester. He was educated with his brother, Prince Frederick, bishop of Osnabrück, afterwards duke of York, in great privacy, and under strict discipline. It was not till 1780 that the princes appeared much in public life. About 1780 the prince became intimate with Fox, Sheridan, and other Whig and Opposition leaders, and with them indulged in all the extravagance and dissipation of the fashionable life of the time. In the Parliament of 1783 he appeared as one of the supporters of the coalition ministry, which in return demanded and obtained an increased establishment for the prince. Increasing debts, however, involved him deeper and deeper in embarrassment, and the subject was, in April, 1787, formally brought before Parliament by Alderman Newnham. A grant of £160,000 was made for the payment of the prince's debts, and £20,000 for the repairs of his residence,

Carlton House, London. It was on this occasion that Fox came to the House, on the express authority of the prince, to allay the excitement that had been caused by a rumour that the prince had married a lady named Mrs. Fitzherbert, who was a Roman Catholic, and that he had thus incapacitated himself to succeed to the crown, according to the Act of Settlement. Fox denied, in the most explicit manner, that any such marriage had taken place. It is, however, now well known that he had been deceived by the prince. Mrs. Fitzherbert at first demanded a public retractation, and although she yielded that point she would never speak to Fox again, who, on his part, complained strongly of the duplicity to which he had been subjected. In the summer of 1791 the prince retired from the turf in consequence of the demand of the Jockey Club that he should dismiss a servant accused of unfair conduct with one of the prince's horses, or should himself retire. Soon afterwards he sold off his horses, shut up Carlton Palace, and began to lessen the amount of his debts. On 31st May, 1792, by his public speech in the House of Lords, he separated himself for a time from Fox and his party, and went over to the minister in the division that then took place on the subject of the French Revolution. In 1794, borne down by the load of his debts, he consented to the only terms on which his father would agree to aid in relieving him from them—marriage; and he became the husband of Caroline Amelia Elizabeth (second daughter of the Duke of Brunswick and of the Princess Augusta of England), 8th April, 1795. Disgust and alienation soon followed. The demand of the princess for the removal of Lady Jersey, whom her royal lover shamelessly kept in office about the princess, was met with a decided refusal; and although a daughter, Princess Charlotte Augusta, was born on the 7th of January, 1796, they separated finally soon after. In 1806 a commission of inquiry into the conduct of the princess was instituted by the prince's friends. That commission decidedly acquitted her of the main charge of having given birth to a child (William Austin) in 1802, but stated that her conduct had been such as to give rise to very unfavourable interpretations. A subsequent minute of the cabinet council, April, 1807, when the Tories were in power, was much more favourable to the princess. On the 3rd of February, 1811, the prince entered on his office as regent during his father's illness, and, to the surprise of all, retained the Tory ministry then in power. On the 2nd of May, 1816, the Princess Charlotte married Prince Leopold, afterwards king of the Belgians, and died in childbed on the 6th of November, 1817. None of the seven sons of the king having at this time any issue, the Dukes of Clarence, Kent, and Cambridge all married in 1818, in order to provide for the continuance of the line of succession.

The prince-regent ascended the throne as king on the death of his father, 29th of January, 1820. The Cato Street conspiracy broke out on the 23rd of February following. The princess, now Queen Caroline, who had gone to the Continent in 1816, returned to London on the 6th of June, and a bill was brought into the House of Lords for divorcing and degrading her. On the 10th of November the third reading of the bill was carried by only 108 votes to 99, and as this division destroyed all chance of the measure being passed by the Commons, the bill was abandoned. At the coronation on the 19th July, 1821, the queen was refused admittance into Westminster Abbey. She was taken ill a few days afterwards, and died at Brandenburg House, Hammersmith, on the 7th of August. Though nothing can excuse the cruelty with which Queen Caroline had been treated by her dissolute and heartless husband during the whole of their married life, and though the never-failing affection of her daughter shows her to have been certainly a very different person from that she was sought to be proved, yet the reader of the memoirs of the time is forced to admit that the poor queen acted very injudiciously. The rabble rout with which she made "pilgrimages" to Jerusalem, the "Jerusalem Order of Caroline," and the other eccentricities of the poor lady, go far to alienate sympathy. As she was deprived of her own child she made matters worse by ostentatiously adopting William Austin and others. Probably much of this arose from the bravado aroused by unmanly persecution in the bosom of a high-spirited woman. The common people hated the king and pitied the queen, and when the king's officers tried to stay the body from passing through London on its way to the grave in Brunswick, the people rose and by barricades forced the funeral to pass through Temple Bar, that they might show honour to the remains. The suicide of the Marquis of Londonderry in 1822 produced some change in the foreign policy of the government. The other chief ministerial changes of the reign were the death of Lord Liverpool, 17th February, 1827, and the accession of George Canning; the death of the latter on the 8th of August, and the formation of the Goderich ministry; its resignation on the 25th of January, 1828, and the appointment of the Duke of Wellington as head, at first, of a ministry of men of differing views, but which ultimately became purely Tory. The chief public events during the same period were the Burmese War in 1825–26; the great commercial crisis of 1825; the destruction of the Turkish fleet at Navarino in 1827, followed on the 6th of August, 1828, by a convention between Sir Edward Codrington and Ali Pasha, viceroy of Egypt, for the evacuation of the Morea by the Turkish troops, and the return home of the Egyptian armament; the success of Lord John Russell's resolution for the repeal of the Test and Corporation Acts on the 26th of February, 1828, followed by the passing of the Act on that subject; the return of O'Connell for the county of Clare, in Ireland, 5th July, 1828, and the enactment in 1829 of the Roman Catholic Emancipation Bill, which received the royal assent on the 13th of April. On the 26th of June, 1830, the king died at Windsor. Among other legislative acts of the reign must be mentioned the general consolidation and improvements of the criminal law by Sir Robert Peel; the Uniformity of Weights and Measures' Act, and the repeal of the combination laws in 1824; the Metropolitan Police Act of 1829; and the substitution of transportation for death in cases of forgery in 1830.

GEORGE OF DENMARK, PRINCE, consort of Queen Anne of England, was the youngest son of Frederick III., king of Denmark. He was born 21st April, 1653. At the battle of Lunden, fought between the Swedes and Danes, 14th December, 1676, Prince George distinguished himself by his bravery, and was the chief instrument in the rescue of his brother, then King Christian V., from the enemy, who had taken him prisoner. In 1683 he was married to the Princess Anne, second daughter of the Duke of York, so soon to become James II. of England. When the revolution came he stayed with James II. almost to the last hour of his sovereignty, and when all men fled from the unhappy king; but at length he also departed from King James at Andover on the night of the 24th of November, 1688, to meet William of Orange at Sherborne Castle, having left behind him a letter to his father-in-law, in which he attributed his secession to zeal for the Protestant religion. Under the new dynasty Prince George was naturalized, and was created an English peer by the titles of Baron of Wokingham, Earl of Kendal, and Duke of Cumberland. He was with William III. at the battle of the Boyne. On the accession of Anne, his wife, Prince George was declared generalissimo of all the forces by sea and land. He was also made lord high admiral; and though the actual power was exercised by Marlborough's brother, Admiral George Churchill, loud complaints were made in 1703, 1704, and

1707 of the administration of the admiralty. Prince George had little capacity and less love for business. The sentence passed upon him by his wife's uncle, King Charles II., a shrewd judge of character, is well known: "I have tried Prince George sober, and I have tried him drunk, and drunk or sober there is nothing in him." How different a character was to be earned by the next prince consort fated to be the mate of an English queen! Prince George died at Kensington Palace, 28th October, 1708, after an illness of several years, during which the queen proved herself a tender and affectionate wife. They had no less than nineteen children, not one of whom lived to inherit the throne. William, duke of Gloucester, who lived the longest, was a boy of great promise; he died 30th July, 1700, at the age of eleven years.

GEORGE, ST., surnamed *of Cappadocia*, was a native of Epiphaneia in Cilicia, and is said to have been born in a fuller's shop. By his parasitical arts he obtained a lucrative commission to supply the army with bacon; but his frauds became so notorious that he fled from justice and went to Alexandria, where he assumed a religious character, and embraced the profession of Arianism with such success that, when Athanasius was driven from Alexandria, George was elevated to the vacant episcopal throne. In this situation he collected a valuable library; but so excited the fury of the people by his avarice and extortions that he was expelled during the reign of Constantius, and was only restored by the military power of the state. On the accession of Julian in 361 George was stripped of his authority and thrown, with two of his ministers, into prison. The popular fury did not wait for the forms of law, and at the end of ten days the prison was forced, George and his associates slaughtered, and their bodies cast into the sea. The Arians introduced his name into the Saints' Calendar in consideration of his services to their cause. When our crusaders went to the East in 1096, they found St. George elevated to the rank of a warrior-saint with the title of the "victorious;" and as they believed that they were indebted to him for aid at the siege of Antioch, they adopted him as the patron of soldiers. Edward III. was thus led to make him patron of the Order of the Garter, and so gradually St. George became the tutelary saint of England.

The above outline of the life and career of St. George is accepted by Gibbon ("Decline and Fall," ii. 323), but the best modern authorities—Protestant as well as Catholic—repudiate the idea that the Arians were able to impose a saint on their enemies, and believe that the real St. George lived much earlier than George of Cappadocia, and probably suffered martyrdom in the persecution under Diocletian; but every account of him contains a strange admixture of fable and history. He is honoured as a martyr both in the Eastern and Western churches. The legend of his conflict with the dragon may have arisen from a symbolical or allegorical representation of his contest with the pagan persecutor.

GEORGE'S CHANNEL, ST., is the name given to the lower part of the sea between England and Ireland. Holyhead and Dublin are its northern points, and St. David's Head and Wexford its southern limits. It has an average width of 60 miles, and its length is about 100 miles.

GEORGETOWN, the capital of British Guiana, in the county of Demerara, and standing on the right bank of the Demerara River, near its mouth, here almost a mile broad. The streets are wide, and it is also traversed by several canals. The town is very attractive in appearance, the houses being mostly neat wooden structures surrounded by luxuriant vegetation; but they are generally built upon piles, on account of the swampy nature of the soil, and the district is exceedingly unhealthy. The principal buildings comprise the government offices, the churches and chapels, a Roman Catholic cathedral, barracks, colonial and seamen's hospitals, banks, theatres, schools, and astronomical and botanical societies. The harbour, on account of a bar, admits vessels drawing 8 feet of water only. The exports are rum, sugar, and coffee. About a mile distant, at the river mouth, is Fort William, and near it is a lighthouse. The Dutch name of the town was *Stabrock*. The population of Georgetown is 40,000.

GEORGETOWN, a city of the United States, in the Federal district of Columbia, separated by Rock Creek from Washington, from which it is 2 miles N.N.W., and of which it may be considered a suburb. It occupies a series of heights rising above the Potomac, and contains a Roman Catholic university, a nunnery, and many handsome villas with extensive gardens, and is the site of most of the foreign legations. Its connection by canal and railway with all parts of the Union gives it the command of a considerable trade. A splendid aqueduct of the Chesapeake and Ohio Canal, 1446 feet long and 36 feet above the ordinary level of the water, here crosses the Potomac. It has some trade in coal and flour, and a large shad and herring market is established for its fisheries. Georgetown was founded in 1751, but in 1878 it was incorporated with Washington. The population in 1880 was 12,578.

GEORGIA, a former division of Trans-Caucasian Russia, now embraced in the governments of Kutais and Tiflis. It was from very early times an independent kingdom under powerful sovereigns, and occupied the region bounded by the Caucasian Mountains on the N., the Black Sea on the S.W., the Armenian Mountains on the S., and the Caspian on the E. Georgia is known among the Russians as *Grusia*, among the Persians as *Gurjestan*, and among the inhabitants themselves as *Iberia*.

This region, which was partially known to the Greeks and Romans, was for many centuries afterwards a theatre of war between the emperors of Constantinople and the kings of Persia. In the eighth and ninth centuries it was under the caliphs of Bagdad, in the eleventh and twelfth it was under the rule of native Georgian kings, in the thirteenth and fourteenth it was under the power of the Moguls or Tartars. Then commenced a splitting up of the region into smaller and separate states, concerning which the Turks and Persians were for two or three centuries frequently at war. The Russians, who had from the sixteenth century begun to acquire some influence in this quarter, made an expedition in 1724 against the highlanders of Daghestan, and took Derbend. This expedition was followed by a treaty with Tamas Shah of Persia, who, being driven from his states by the Afghans, ceded to Russia, on the promise of being restored to his throne, the provinces of Daghestan, Shirvan, Ghilan, Mazanderan, and Asterabad. Although the promised assistance was never given, the provinces were taken possession of by Russia, and held till the year 1735, when they were restored by the Empress Anne to the celebrated Nadir Shah. After the death of Nadir, Georgia was for many years under native kings, who sought Russian protection against Persia; and at the death of one of these kings in 1800 Georgia was declared a Russian province, and the members of the reigning family were carried to that country. Other provinces in this region gradually fell into the hands of Russia, and were confirmed to it by treaties made in 1813, 1828, and 1829. The mountain-ranges of this region are described under ARARAT and CAUCASUS.

The principal rivers which drain the Caucasian isthmus are—the Koor, or ancient *Cyrus*, the Araxes, the Rion or Faz (the ancient *Phasis*), the Kooban, and the Terek, besides numerous smaller rivers and streams.

The country, though generally mountainous, contains some extensive plains. The climate is very varied. Of

wild animals there are the panther, the jackal, the tiger, the bear, the wolf, &c. Besides the domestic animals common to the northern countries, there are great numbers of camels and asses. The slopes of the mountains are covered with large forests, which produce timber of the best description. The chief vegetable products are pomegranates, corn, grapes, cotton, madder, rice, and saffron.

Coal, iron, naphtha, and other minerals are supposed to be abundant, but few mines are worked. The present commerce of these countries by the Caspian Sea is carried on from the ports of Derbend, Baku, Shamakhi, and Lenkoran, to Persia and to Astrakhan. The overland trade is with Russia and Persia, as well as with Asiatic Turkey. The commerce by the Black Sea is carried on from the mouth of the Rion with Odessa and other Russian ports, as well as with Constantinople; and there is a small traffic with the highlanders of the Caucasus.

The whole region is under a Russian governor, who resides at Tiflis. The Georgians are supposed to be descendants of the natives of the Pambaki Highlands, who migrated westward at a very early period of the world's history. They are characterized by many fine qualities, and are distinguished by great personal bravery. The women have usually oval faces, fair complexions, and black hair; and though not generally reckoned handsome by Europeans, they have long enjoyed the highest reputation for beauty in the East; the men are also, on the whole, well formed and handsome. This superiority in the physical form of the Georgians and other contiguous Caucasian tribes, and the low state of civilization that has always prevailed among them, explains the apparently unaccountable fact that these countries were from the remotest antiquity down to our times the seat of an extensive slave-trade. Previously to the Russian conquest the slaves were the absolute property of their lords, who, besides employing them in all manner of manual and laborious occupations, derived a considerable part of their revenue from the sale of their sons and daughters. Indeed, the daughters of the nobles not unfrequently shared the same fate, being sacrificed to the necessities or ambition of their unnatural parents.

GEORGIA, one of the thirteen original states of the United States of North America, in the southern part of the Union, extends from north to south between 30° 30′ and 35° N. lat., and from east to west between 80° 50′ and 85° 40′ W. lon. It is bounded N. by Tennessee and North Carolina, N.E. by South Carolina, E. by the Atlantic Ocean, S. by Florida, and W. by Alabama. Its length, north to south, is 320 miles; its greatest breadth is 256 miles. The area is 58,000 square miles. The population in 1880 was 1,542,039, of whom 725,133 were coloured.

The line of coast, extending 105 miles in a straight line, runs from S.S.W. to N.N.E., with a slight bend westward. It is very irregularly indented, and skirted by numerous low islands, the principal of which are Tybee, Ossabow, St. Catherine, Sapello, St. Simon, and Cumberland. These islands, as well as some tracts on the adjacent shore, have a light rich soil, well adapted for the culture of cotton. The cotton grown here, known by the name of Sea-island Cotton, fetches a higher price in the market than any other, but since the War of Secession it has been little cultivated. The inlets and sounds which divide the islands from one another, and penetrate several miles inland, are generally very shallow, and admit only vessels of less than 100 tons. Vessels of larger dimensions can enter only three harbours, St. Mary's, Alatamaha, and Savannah.

The surface of Georgia is naturally divided into two regions, a plain and a hilly country. The plain is a dead flat along the shores of the ocean, with a sandy soil. In many places it is intersected with swamps. The largest of these swamps is the Okefinoke, near the boundary of and partly within Florida, which is about 50 miles in length and 30 in breadth. This swampy tract ceases about 50 or 60 miles from the sea, except the Okofinoke, which lies further inland. On the rich soil of the coast are the rice plantations. West of the swampy tract the soil is dry; but, being commonly destitute of water, it is nearly unfit for cultivation, except along the bottoms of the rivers. The hilly region, which occupies nearly the northern half of the state, contains a much greater portion of arable land. The best land is along the rivers. The declivities of the hills also contain large tracts of arable land, but their dry and sandy summits do not admit of cultivation, and are covered with pines. The most southern ridges of the Appalachian Mountains occur along the northern boundary line of Georgia, but they are not lofty; seldom, if ever, exceeding the height of 1500 feet above the level of the sea.

The principal rivers which drain Georgia are the Etowa, Appalachicola, and its branches the Chattahoochee and the Flint, the Alatamaha, and the Savannah. They fall partly into the Gulf of Mexico and partly into the Atlantic. The hilly region of Georgia is rather cold in winter. The plain approaches in its temperature the tropical regions of the globe. The thermometer in summer sometimes rises to 98° or 100°. In winter it ranges between 60° and 40°, and occasionally sinks lower. The weather, however, is then dry and constant.

In the southern districts the temperature is suitable to the sugar-cane, orange, olive, fig, pomegranate, &c. The chief product is cotton, of which large quantities are exported, but tobacco, as well as maize, wheat, and other kinds of grain, are also grown. In some parts the soil has been much impoverished by a bad system of culture. The hilly region resembles Middle Europe in climate and products, and much of it is covered with pines, and some of it with oak, hickory, cedar, and other trees. Bears and deer are very numerous in the forests and near the swamps. Alligators frequent some of the rivers.

The whole population of Georgia is now composed of Europeans and Africans, or their descendants. Not a trace remains of the old Indian population. The minerals of this state comprise gold, silver, copper, iron, coal, marble, limestone, and granite. There are manufactories of cottons, iron-works, and tanneries, and altogether about 2000 miles of railway are now open. There is a state lunatic asylum, deaf-mute asylum, and a state penitentiary; churches of all denominations; five colleges, with large libraries; theological and medical schools; a female college, and many public schools.

The colony of Georgia was founded in 1732 by a private company as a refuge for English debtors, assisted by a grant from the House of Commons, and received its name in honour of King George II. In 1733 General Oglethorpe founded the town of Savannah. The present constitution was formed in 1798, and amended in 1839. The legislative body is composed of a senate and a house of representatives. Every free white male citizen twenty years of age, and paying taxes, has a vote in the election of the members of both houses. The state sends two senators and eight representatives to Congress, and has ten votes for the president. In the late American civil war Georgia was one of the Confederate states, having been the fifth to secede from the Union. For the first three and a half years it experienced the usual vicissitudes of the war, but in the latter part of 1864, and early in 1865, it became the scene of special attention, in consequence of the capture of Atlanta and the subsequent march of the Federal general, Sherman, through the entire state, which ended in the capture of Savannah and the subsequent fall of Charleston and Wilmington; as these events demonstrated more clearly than anything had previously done the deficiency of men and resources on the part of the Confederates, there can be no doubt that they materially hastened the end of the war.

GEORGIA, GULF OF, is an inlet of North-western America, separating Vancouver Island from the mainland, lat. 49° N., lon. 124° W. It communicates with the Pacific Ocean on the north by Charlotte Sound, and on the south-west by the Straits of Juan de Fuca. The average breadth of the gulf is about 20 miles.

GEORGIUM SIDUS. See URANUS.

GE'OTRUPES. See DUNG BEETLE.

GEPHY'REA, a class of VERMES, contains small worm-like animals, having long cylindrical bodies, without distinct separation into segments. The cuticle is chitinous, and in some species is provided with bristles. There are no feet. The head is not distinct from the body; it is produced into a retractile proboscis, at the tip of which opens the mouth, surrounded by short ciliated tentacles. In some species the tentacles are absent, and the mouth is situated at the base of the proboscis. The alimentary canal is long and usually coiled; the inside is ciliated. The anus is placed at the posterior end of the body, or is dorsal in position near the anterior third of the body, or it may even be situated at the base of the proboscis. A calcareous skeleton is never present. The vascular system consists generally of two longitudinal trunks, one ventral, running along the wall of the body, and one dorsal, following the track of the alimentary canal. In the genus Sipunculus both vessels communicate with a circular vessel surrounding the œsophagus and giving off vessels to the tentacles. In some other genera, as Echiurus, the vascular system is more elaborate. Two kinds of excretory organs are found in the Gephyrea. In Sipunculus, Echiurus, and other genera organs similar to the nephridia of the earthworm and other Annelida are found, serving in some cases wholly or partly as ducts for the generative products. In Bonellia the excretory organ is different, consisting of tubes opening into the rectum, provided with numerous ciliated funnels which open into the cœlom, or body-cavity. This organ exists in a degenerated form in Echiurus and Thalassema. In some the tentacles function as respiratory organs, in others special developments occur. The nervous system is simple, consisting of a collar round the œsophagus, from which proceeds a ventral cord giving off lateral branches, but showing no distinct ganglia. Eye-specks are present in a few; of the other senses touch is the only one developed. The sexes are distinct. In the development from the embryo to the adult metamorphosis amounting to metagenesis occurs, only part of the larva growing into the adult form. The larva is free-swimming and ciliated. The Gephyrea live in the sand of the sea-shore near high-water mark, or among the debris of broken shells, or on the sea-bottom at great depths. Their food appears to consist of the sea mud, mixed up with organic particles. Some of the species perforate submarine rocks and lodge in the cavities so made, or take possession of old shells, like the hermit crabs.

The Gephyrea are widely distributed. About 120 species are known, varying from half an inch to 8 or more inches in length. The class may be divided into the following families:—Sipunculidæ, of which Sipunculus and Phascolosoma are the chief genera; Priapulidæ, with typical genus Priapulus; Echiuridæ, containing Echiurus, Bonellia, Thalassema. Sternaspis is now referred usually to the Polychæta. Phoronis forms a division of the Gephyrea, distinguished as Tubicola, from the fact that like the sedentary Polychæta it inhabits tubes.

GEP'IDÆ, THE, are best known to us through their destruction by the Longobards or Lombards at the command of Justinian, to whom they had become dangerous. They were a branch of the Goths, who at first conquered and dwelt in Scandinavia, and later migrated to the southern coast line of the Baltic between the Oder and the Vistula. These seats they forsook under the leadership of Attila, and when his great host dispersed at his death the Gepidæ found a home still further south, on the Danube, in the district called Dacia. Here they flourished, as has been said above, till the timid and frightened Emperor Justinian found means to embroil them with the Longobards, succouring the latter just sufficiently to keep the war alive, but yet not enough to bring about a decisive conquest, lest these, too, might in their turn become a danger. It was, indeed, only after thirty years of warfare between these kindred nations that the young Alboin finally subdued and destroyed the Gepidæ. The skull of Cunimond, the king of the brave Gepidæ, was fashioned into a wine-cup, with a silver rim, after the terrible German fashion of these barbaric times. Alboin not only forced Rosamond, the daughter of Cunimond, to become his wife, but at one of the brutal banquets of his followers insisted on her pledging the soldiers out of her father's skull. The vengeance was swift, the outraged queen finding means to have Alboin assassinated.

GERANIA'CEÆ, an order of plants belonging to the POLYPETALÆ. These plants are usually astringent and odoriferous, their smell varying from a disagreeable hircine character to that of great sweetness. The maximum of the order occurs at the Cape of Good Hope under the form of the genus Pelargonium, hundreds of beautiful varieties of which are now favourite objects of cultivation in gardens; these are chiefly bushes. Those species of the order which inhabit Europe are herbaceous plants; a few are handsome enough to be cultivated, but the major part consists of mere weeds. The flowers of the whole order are usually of some tint of purple; it is therefore remarkable that a few species should exist in which the colour is a pure bright yellow, as in *Geranium chrysanthum*, a native of the south of Europe. Geraniaceæ are herbs or shrubs, with five sepals, generally free; five petals, ten stamens, ovary with three to five lobes, and one or two ovules in each of the five cells. The wood-sorrels (Oxalidæ) are included by Bentham and Hooker in this order; OXALIS and AVERRHOA are the chief genera.

GERA'NIUM, a genus of plants, the type of the order GERANIACEÆ. *Geranium Robertianum* has small bright crimson flowers, and is found on waste ground, walls, and river banks in Great Britain and America. The whole herb has a strong disagreeable smell. It contains tannin, and has an astringent action on the system. *Geranium maculatum* (spotted crane's-bill) is a native of North America, from Canada to North Carolina. The flowers are of a pale lilac colour. On account of the astringent nature of this plant it is known in some parts of North America as alum-root, and is employed successfully as a remedy in dysentery among children, a disease very prevalent in the parts of the country where it grows. Geranium is distinguished by its regular flowers; the ten stamens united at the base; five carpels adherent to a central axis from which they separate when ripe by the elastic curling back of the segments of the style. Erodium is distinguished by the style segments twisting spirally. Pelargonium, to which genus the garden geraniums belong, has a spur adherent to the flower-stalk.

GER'BER, ERNST LUDWIG, an eminent musical historian, was born at Sondershausen in 1746, and died there in 1819. His father, Henry Nicholas Gerber, was the son of a peasant, but studied at Leipzig, and taking to the pursuit of music under the encouragement of no less a person than Sebastian Bach, came to be the court-organist and court-secretary of Sondershausen. The son of the organist devoted himself to the literary side of music more fully than to the practical, although he was a composer of small works for organ and pianoforte of no mean merit. His "Biographical Lexicon of Musicians" first appeared in 1790, but the "New Biographical and Historical Lexicon of Musicians" which he brought out in 1812, was a far more complete work, correcting and amplifying the

former. He presented his fine collections of music and musical books to the Association of Friends of Music at Vienna, with the sole condition that it was to be under his control as long as he lived. His work has been the basis of all succeeding histories and dictionaries of music.

GER'BERT VON HORNAN, MARTIN, a distinguished musical antiquary, was born at Horb in the Black Forest in 1720, and died in the Benedictine monastery of St. Blaise, of which he had been for eighteen years the prince-abbot, in 1793. He fully sustained the great reputation for studious scholarship which has long attended the Benedictines, and obtained permission to undertake a long six-years' journey through all the chief towns of the Continent, amassing materials for the history of music. Subscriptions were liberally forthcoming to one who was beloved wherever he was known, and respected as much as loved. But just as the work was about to appear the monastery caught fire and all was destroyed. Not till 1768 could a new edition be got ready. It is not too much to say that Gerbert's history is the foundation of all musical antiquarianism. It is still valuable, though much has since been discovered. In 1784 his great collection of famous old treatises on ecclesiastical music appeared, a work which created the study of this most interesting and intricate branch of musical history. It is also to Gerbert that we owe the deciphering and translation of the very ancient tenth-century musical treatise by Notker, abbot of St. Gall, a work simply priceless.

GER'BILLE (Gerbillus) is a genus of Rodents belonging to the extensive family MURIDÆ. The Gerbilles are little nocturnal burrowing animals, very similar in their habits to the jerboas. They are natives of Africa, India, and the south-east of Europe, tenanting plains and sandy districts; and are very quick and active, leaping with great agility. Though the gerbilles have the posterior limbs developed, their development is by no means to the same extent as in the jerboas, and there is a far more equal proportion between them and the anterior pair; hence these animals run as well as leap. They hoard up grain in their burrows, and sit up while eating, like a squirrel. The body is plump, the head broad, the neck short, and the muzzle pointed. The thumb on the fore-feet is reduced to a mere wart. The tail is long and hairy. The molar teeth have roots, but their crowns are not tuberculate. The species are not very numerous.

GER'FALCON. See GYRFALCON.

GERMAIN-EN-LAYE, ST., a town in France, in the department of Seine-et-Oise, stands on the left bank of the Seine, 14 miles W. by N. from Paris, and had 14,086 inhabitants in 1881. It is situated on a height which commands a beautiful prospect of the valley of the Seine, with a distant view of Paris and its environs. The streets are handsome and well laid out, and the houses lofty and well built; there are many ancient mansions, once the residence of the lords of the court, before Louis XIV. forsook this place for Versailles. The château, or palace, which replaced a more ancient royal residence, and was built by François I., is built chiefly of brick, surrounded by wide and deep ditches; the apartments are handsome. Among its many historical associations must be mentioned that it was the residence of James II. of England, its last royal occupant. After his death in 1701 it was neglected till 1809, when Napoleon established in it a military school. In 1815 a body of 10,000 English were quartered in it. It afterwards served for a barrack for the royal guards. Since 1862 it has been used as a museum of Celtic and Roman antiquities. The Château-Neuf, built by Henri IV. for his mistress Gabrielle d'Estrées, is now a heap of ruins. The forest or park of St. Germain, surrounded by walls, and occupying nearly 9000 acres, is adorned with trees of immense size, and has numerous broad avenues. In the forest are several edifices, erected at different periods by the kings of France. The most remarkable of these is the structure called Les Loges, formerly a monastery, now an orphan school, in which orphans, daughters of members of the Legion of Honour, are brought up. The fair of Les Loges, held on the first Sunday after the 30th of August, and lasting three days, is one of the gayest in France; it is attended by great numbers of country people and Parisians. The inhabitants of the town of St. Germain-en-Laye are chiefly employed in manufactures of cotton, hosiery, horse-hair, and leather.

GERMAN LANGUAGE AND LITERATURE. The German language is divided into two great branches, which are subdivided into several dialects: the *High German* (Hoch Deutsch), or language of southern Germany; and the *Low German* (Platt Deutsch), or language of northern Germany. The High German was formerly divided into two dialects, the Francic and the Allemannic. The Francic was the idiom of the Franks and of the French court till the reign of Charles the Bald, when it was replaced by the French. The Allemannic dialect prevailed in the south-western part of Germany.

The modern German, also called New High German, may be considered as chiefly derived from the old southern dialect. Its universal usage as the literary language of all Germany dates from Luther's translation of the Bible, that being made in this dialect, by which circumstance it acquired a decided superiority over all the dialects of Germany. It is divided into Old, Middle, and New High German; the twelfth century and the Reformation being the points of division of these periods.

The Low German may be also divided into the Old Saxon, the Low German of the middle ages, and the modern Low German. The first of these three prevailed from the eighth to the eleventh century; the second from the eleventh to the sixteenth; the third is the spoken (but not the written) language over great part of the north of Germany, and is itself subdivided into many dialects. The Frisian language is also a branch of Low German, and the English language is a derivative from that. Flemish and Dutch are other languages of this great group. Recent research has quite disposed of the opinion formerly held that the Low German was a derivative of the High German, or *vice versâ*. At all events it is not proved. All that can be said is that the two are found independently existing, and as widely separated as they now are, at the very earliest times of which we have records. It seems possible, therefore, that they represent two distinct offshoots of the great Aryan stock, taking place at nearly the same period of its development, so that their differences are slight as compared with those between other branches, as the classic tongues, or the Celtic, &c. It is quite certain that the separation of the Teutonic races from the Aryan stock occurred *after* the separation of the Celtic; and further than this at present philologers cannot make any well-founded conjectures.

A third form of German is that only known to us by one relic, which is at the same time the most ancient monument of German literature extant—the translation of the Bible into the Gothic language by Bishop Ulphilas in 360. This translation was that used by the Goths in their time of power, and exists in a MS. only a century after the date of the bishop himself. It is not in a very perfect state, it is true, but it is one of the most interesting fragments of all literature. It was discovered in the abbey of Werden about 300 years ago. With the gospels are portions of commentaries and a few other fragments of the bishop. He was of the Arian school of Christians. The language, while closely allied to German, is yet most artificial in structure. Indeed, its great value lies in the points of resemblance it possesses to Greek, thus clearly proving the connection of Teutonic and classical speech. These points are, briefly—the possession of a *dual* and of

a middle voice; a large variety of inflexions and an abundance of radicals; the coexistence of strong and weak inflexions in very complete forms; the absence of tenses in the verb, except the present and past; and the arrangement of the syntax. The language entirely died out in the ninth century.

The reign of Charlemagne may be considered as the commencement of German literature, although there are some fragments of translations from ecclesiastical books which were probably made prior to that epoch. After this reign, the Christian religion being established throughout all Germany, many fragments of the Bible and some ecclesiastical writings were paraphrased from the Latin into the vulgar tongue. In the time of Otto I. Archbishop Bruno founded a famous school in Köln (Cologne), and Hroswitha, abbess of Gandersheim, wrote in Latin comedies in the style of Terence. As yet in literature and art nothing but Roman models were followed.

But with the Franconian emperors the national spirit showed itself in the dawn of a literature, and the time of the succeeding dynasty, the emperors of the Swabian family of Hohenstaufen, is the golden age of the Gothic architecture and of the romantic or chivalrous poetry of Germany. This poetry, being written in the Swabian dialect, which came into fashion through the influence of the reigning family, is generally called the Swabian. The poets of that period are known under the name of Minnesingers, from the Old German word *minne*, which signifies love. Frederick II. himself was a very renowned troubadour. The subjects of the Minnesinger were chiefly Charles the Great, Arthur and the Round Table, &c., and their greatest poets were Wolfram von Eschenbach, Gottfried von Strasburg, Hartman von der Aue, and Walther von der Vogelweide. Wandering bards told more purely German tales, and these being put together and made roughly into an artistic whole, produced those treasures of the middle ages, the epics of the Nibelungen-lied, Gudrun, &c., and the rough pungent satire of Reinecke Fuchs (Reynard the Fox) and Tyll Eulenspiegel.

To the next epoch belongs the commencement of the original dramatic literature of Germany, which is due to the Meistersingers' school of Nuremberg. Before that period the Germans were only acquainted with the so-called mysteries or dramatized biblical stories, written and performed for the most part in Latin. About the middle of the fifteenth century Hans Volz, a barber by profession, Rosenblut, and some others introduced a kind of farce called "Carnival Plays." They were all excelled by Hans Sachs, of Nuremberg, a shoemaker by profession, who lived from 1494 to 1576; his works are full of wit and invention, and next to the Spanish Lope de Vega, he is regarded as one of the most fertile of dramatic writers. Sachs did good service also to the cause of the Reformation by his popular humour. The architecture, like the literature, is now renaissance in style.

Many historical and allegorical poems were written during this period of the sixteenth century, and several ballads and other metrical productions were rendered into prose, which may be considered as the commencement of the novel in Germany. The names of Luther, Zwingli, and Ulrich von Hutten, writers of the all-absorbing Reformation, are, however, the great names, and constitute the literature of the epoch. Indeed, the Reformation of Luther gave an extraordinary impulse to the national literature of Germany, and Luther himself contributed more than any other man to the advancement of the German language, which may be considered as having been fixed by his translation of the Scriptures. Among the poets we may mention Luther himself, who composed many religious songs, Rudolph Weckerlin, Nicolai, Paul Flemming, Gerhardt, and above all Opitz.

Among the prose writers were the mystical authors, or the so-called theosophists, who united the study of divinity and metaphysics with that of natural philosophy. The most celebrated are Paracelsus and Jacob Böhme. The historical writers were not numerous; the best among them was Puffendorf. In science the names of Gesner, of the inventor of the air-pump, Otto Guericke, and of the great astronomer John Kepler, occupy a distinguished place.

In consequence of the demoralizing effects of the Thirty Years' War, when Germany was a prey to all the evils inseparable from civil war, fostered by foreign interference, its literature became either stagnant or very much degenerated, and down to a late period of the eighteenth century was at a very low ebb. The higher classes aped the habits, language, and literature of Versailles, and the lower orders forgot their own noble literature and acquired a taste for the coarse camp songs introduced by foreign mercenaries, and the immoral romances borrowed from French and Italian sources. Gottsched roused the German nation from this languor by vigorous onslaughts. In 1767, Lessing, by means of a periodical devoted to theatrical criticism which he conducted, drew popular attention to the state of the dramatic art; and the boldness and acuteness with which he attacked the prevalent taste in tragedy were so successful that in a short time not only the translations of French tragedies, but the German tragedies modelled after them, disappeared from the stage. He was the first who spoke warmly of Shakspeare, and paved the way for his appearance in Germany. Lessing has himself been the subject of much criticism in later times; but his plays of "Minna von Barnhelm," "Emilia Galotti," and above all the magnificent "Nathan the Wise," were the starting-point of German dramatic literature. Lessing further created in the "Laokoön" the philosophical criticism of art, as well as founding the drama; and all these various services were perhaps eclipsed by the new power which the language gained in his hands. In a less degree his contemporaries the poets Wieland and Klopstock contributed to this great work; the latter was long called (rather absurdly) the German Milton; and Coleridge and Wordsworth as young men made a pilgrimage on purpose to see the venerable author of the "Messiah" in his old age. Not so the philosopher Leibnitz, at the end of the previous century. Disdaining German as the vehicle for his thoughts he wrote in Latin and French. Not one single work of his voluminous literary baggage appeared in his native tongue. His philosophy, though not his unnatural behaviour to his mother tongue, was continued by Wolf. But both as philosopher and as writer Leibnitz was thrust aside by his successor, Immanuel Kant. In the "Critique of pure Reason" (1781) Kant struck a new note in metaphysics. Philosophy was at once raised beyond the mere scholastic exercises of pedants, and became a living, growing force. In glowing eagerness the best powers of Germany were lavished (some would say wasted) on the new school of thought thus inaugurated. Fichte, Schelling, and Hegel followed in quick succession. (Schopenhauer, Schleiermacher, and Von Hartmann are distinguished successors of these three.) These men were Germans to the heart. In 1813 when the drums were beating to the last rally against Bonaparte, Fichte told his class of students that the lectures would be "resumed when the country was free," and shouldering a musket marched off with the first regiment. Hegel finished his great work to the sound of the cannon in the great battle raging beyond the walls of Jena. At the same time scholarship was well forwarded by the artistic Winckelmann and by Heyne; and a combination of all the elements already named, poetry, philosophy, and classical scholarship, was represented by the accomplished Herder.

But the figure which towers above all others, and indeed which dominates the entire intellect of Germany, is the colossal Goethe. His romantic and sentimental "Werther," his philosophic "Wilhelm Meister," almost an epitome of life

in itself, his flawless lyrics, his grand classical plays, such as "Iphigenie" or "Tasso," his poems, as "Hermann and Dorothea," and his supreme effort of all, the "Faust," incomparable to anything in German literature, and indeed in depth of meaning surpassing everything ever written, save by Shakspeare and Dante—what a stupendous collection of masterpieces they make up!

As the leading object of Goethe seems to have been to give his genius the fullest possible expression, he made himself master of every form, though he proved greatest in the dramatic. He was at the same time a warm friend to the theatre, and sometimes laboured to comply with its wants as determined by custom and the taste of the day. The consequence of this has been, that there is a singular variety in the subjects and treatment of his plays.

Meanwhile, shortly after the first appearance of Goethe, a very vigorous effort had been made to bring Shakspeare upon the German stage. His own criticism and full account of "Hamlet" is one of the most remarkable episodes in "Wilhelm Meister." The plays, however, had the disadvantage of appearing in cumbersome prose translations, and often in mere abstracts, with disfiguring alterations: the separate characters and situations had been to a certain degree hit, but by no means the sense of the composition.

Under these circumstances appeared Schiller, endowed with the qualities requisite for producing a strong effect on the multitude, as well as on the minds of a higher cultivation. Though his genius was daring in the highest degree, yet in the works of his youth he was influenced by the models of Lessing, by the earlier productions of Goethe, and by Shakspeare, so far as he could understand him without an acquaintance with the original. At a later date he sought his materials more completely from within. His "Robbers," "Don Carlos," "Wallenstein," "Maria Stuart," "Maid of Orleans," "Bride of Messina," and "Wilhelm Tell" form collectively a monument of dramatic skill. How much further Schiller might have carried the advancement of the German drama it is difficult to estimate, as he attained with every fresh work a higher mastery in his art; but he was carried off by an untimely death in the full maturity of his mind. The close unbroken friendship between Goethe and Schiller is one of the finest episodes in the history of literature, too often a record of petty jealousy and mean rivalry.

To those who can appreciate his ironical humour, which is as hard to fall in with for many people as the very similar work of Carlyle in later England, and to those who are not driven away by the intense difficulty of his literary style, Jean Paul Richter is one of the most delightful and suggestive writers who ever existed. His "Flower-fruit-and-thorn Pieces" (Blumen-frucht-und-dorn Stucke) are charming, when the author's manner is once mastered; and the thoughts on education in the "Levana" are among the most luminous of the later "pedagogy."

In the present century Germany still must be admitted to hold the foremost rank in literature in most departments except that of light comedy, for which we must go to France, and that of natural science, in which she is excelled by England. The wars of Napoleon brought forth the soul-stirring strains of Körner and Arndt. Uhland's ballads and romances and Rückert's oriental translations are exquisite productions. Laube, Gutzkow, and Freiligrath are singers of later date and of less fire. The finest poet since Goethe is, however, the curiously-mingled Heinrich Heine; never quite in earnest, never altogether cynical, always polished and charming, and original in every syllable, he presents his readers with an endless changeful succession of fascinating enigmas which do not pall. The number of musical settings to his famous lyrics is portentous. Many songs are honoured by the separate melodies of Mendelssohn, Schumann, Liszt, and Franz, each viewing the few lines of the poet from a different musical standpoint.

As in France and in England, so also in Germany the novel is, however, the form in which our century best expresses itself. The earlier writers are the followers of Schiller's romanticism, the Schlegels, Tieck, and Novalis (Hardenberg), turning rather towards mediæval subjects. More purely romantic were the delightful De la Motte Fouqué, author of the exquisite "Undine," Chamisso, Brentano, the fantastic and mysterious Hoffmann, and Immerman. The Countess Ida Hahn-Hahn, Auerbach, and Freytag are later novelists of the first rank.

The special history of several nations and countries has been treated in Germany with a degree of research, patient industry, and sound judgment, in which the Germans have surpassed all the rest of their European contemporaries. To this class belong Maylath's "History of Austria" and that of Hungary. Lappenberg's "History of England" was among the first of great works on the historical sources of the Saxon period of our history. (Freeman's researches have now restored the palm to England, however, in this department.) Especially are the Germans strong in musical historians. Chrysander's Handel, Spitta's Bach, John's Mozart, Pohl's Haydn, Thayer's Beethoven, &c., are models of historical biographies. Nothing like them exists elsewhere. Wagner's writings on musical subjects are also weighty, and have had influence enough to demand mention in an account of German literature. Von Hammer has written a history of the Turks, founded on Oriental authorities; Geijer, of Sweden; Kampen, of the Low Countries; Raumer, the history of the Hohenstaufen dynasty; Luden, Menzel, and Pfister, each a history of the Germans; Voigt, a history of Prussia; and Wilken, a history of the Crusades. Ranke's "History of the Popes;" Niebuhr's new views of Rome, quite revolutionizing the history of that people; Mommsen's magnificent "History of Rome;" Curtius' equally fine "History of Greece," are all epoch-making books. Schlosser, Leo, Gervinus, Dahlmann, Hausser, Von Sybel, and Waitz are also distinguished historians. One cannot help a patriotic pleasure, however, in feeling that the greatest historical work of the century, and that, too, on Prussia's great hero (Carlyle's "Frederick the Great."), is the work of an Englishman. Translated into German, and universally read, it is held as great a masterpiece in Germany as in England.

The Germans have produced many valuable works on the history of the human mind, on the progressive civilization of the human race, and on the history of literature and art. Adelung's "Essay on the History of the Civilization of Mankind" is a work of considerable merit, but is surpassed by Herder's "Ideas on the Philosophy of the History of Mankind." Jenist, Eichhorn, Waltman, Stapfer, Pölitz, Schueller, Meiners, Bouterwek, Meusel, and Wachler wrote also on similar subjects. The two Schlegels occupy a distinguished rank as critics. Ecclesiastical history has engaged the pens of Mosheim, Schrökh, Tzchirner, Neander, Rhode, Münter, and others. The history of philosophy is treated in the compendiums of Eberhard, Gurlitt, and Socher; and in the extensive works of Tiedemann, Buhle, Tennemann, and H. Ritter. Fischer wrote a history of natural philosophy; Gmelin, of chemistry; Hoyer, of the military science; and Stäudlin, of the theological sciences. The "History of Medicine," by Sprengel, is probably superior in real merit to any other work of the kind.

Geographical science has been most successfully cultivated in Germany, indeed it might be said that Germany is its birthplace. Cellarius, Mannert, Ukert, Sprengel, Bischoff, and Möller were voluminous geographical writers. Modern geography was for the first time treated on something like a system by Büsching, whose "Universal Geography," in ten parts (1754–92), was long considered a standard work. The most distinguished writer on these subjects since Büsching is Ritter, whose researches still lead German geographical science.

Germany has also produced many eminent writers on every branch of jurisprudence, among whom are Eichhorn, Hugo, Savigny, Thibaut, Gans, Feuerbach, Konopach, Mittermaier, Puchta, Vangerow, and Kleinschrod.

But numerous as have been the writers in other departments of literature in Germany during the present century, the tendency of the German mind has of late years been chiefly directed to science, philosophy, and theology. The immense impetus given to the taste for scientific inquiry by Humboldt's travels and observations, and by his "Cosmos" and "Views of Nature," has been followed by the most profound researches in every branch of physical and natural science, and by the appearance of a multitude of records of travel by Germans in every part of the world. The astronomers Zach, Encke, and Gauss, the comparative anatomist Oken, the biologists Haeckel and Gegenbaur, the physicists Helmholtz, Meyer, Bunsen, and Kirchhoff, the chemists Müller and Liebig, are leaders of the world. Philosophy has already been spoken of above.

It is, however, in the domain of theology that Germany has recently exercised such a marked influence over the literature of Europe, more especially that of England. Among the writers on the conservative and orthodox side are the Catholic divines Jahn and Hug, and the Protestant writers Hengstenberg, Havernick, Kurtz, Guerike, Delitzch, and Caspari; while on the other side are Berthold, De Wette, Credner, Reuss, Strauss, and the "Tübingen school," with Baur at its head. The researches and criticisms of these and other writers have infused quite a new life into biblical inquiry.

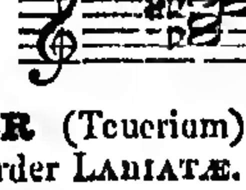
One science the Germans may be said to have invented, and that is philology, or the science of language itself. This is due to the researches of Grimm ("Deutsche Grammatik"), Bopp, Pott, Benfey, Adelung, Lepsius, Bunsen, &c. GRIMM'S LAW as to the development of Aryan languages is certainly entitled to rank with Darwin's Natural Selection and Kirchhoff's Spectroscope. It created a science where before all was conjecture and empiricism. Wolf, K. O. Müller, Hermann, Böckh, and Bekker worthily advance the classical side of scholarship.

GERMAN OCEAN. See NORTH SEA.

GERMAN PASTE is a preparation used for feeding singing birds, such as larks, thrushes, and nightingales, and is made of the following ingredients:—Three eggs boiled hard, 2 lbs. of pease-meal, ½ lb. of fresh butter or lard, ½ lb. of sweet almonds, and 5 ounces of moist sugar, mixed with water and beaten into a paste, which is exposed to the air and warmth till it is hard and dry. It will keep good for many months if properly made, and is an excellent substitute for the natural food of singing birds.

GERMAN SILVER is an alloy composed of 100 parts of copper, 60 of zinc, and 40 of nickel. It is largely used in the arts, is very malleable, and takes a high polish. Almost the only use made of nickel is in the preparation of this substance.

GERMAN SIXTH. As was said in the article FRENCH SIXTH, these special names for certain varieties or inversions of the chord of the Augmented Sixth are rapidly becoming obsolete, which renders it perhaps the more necessary to explain their meaning here. The German Sixth is when the minor ninth of the dominant forms the bass of the chord, the remaining notes being, in the order of their occurrence from the bass, the keynote (in the character of seventh to the supertonic), the minor ninth of the supertonic, and the major third of the same. The chord presents the following appearance in the key of C:



GERMAN'DER (Teucrium) is a genus of plants belonging to the order LABIATÆ. *Teucrium Scorodonia* (wood germander or sage) is a native of Europe in woody hilly situations, where the soil is dry and stony. It is not an uncommon plant in Great Britain. Its smell and taste very much resemble the hop. In Jersey, where it is called ambroise, the inhabitants use it as a substitute for hops in their beer; and by some persons the bitter given by the germander is preferred to that of the hop. *Teucrium Scordium* (water germander) is a rare plant in Britain. Its fresh leaves are very bitter and rather pungent, having a smell similar to garlic. *Teucrium Chamædrys* (wall or common germander), a native of Europe and some parts of Asia, on walls and rocks and dry places, is only rarely found in Great Britain. *Teucrium Marum* (cat-thyme) belongs to the region of the Mediterranean. The leaves emit when rubbed a strong aromatic smell, which excites sneezing, and on this account it has been used medicinally. In this genus the calyx is tubular, five-toothed, sometimes slightly two-lipped. The tube of the corolla is shorter than the calyx; the upper lip is short, the lower is much longer and spreading. The four stamens project beyond the corolla.

GERMAN'ICUS CÆSAR was a nephew of the Emperor Tiberius. He was the son of Nero Claudius Drusus the Younger, brother of Tiberius, by Antonia, the daughter of Mark Antony. Germanicus was born B.C. 15. He was adopted by Tiberius during the lifetime of Augustus. He not only filled the great offices of state with credit, and during all his life wrote poetically and with elegance; but he was personally beloved by the common people, especially by the army, to whom the austere severity of Tiberius was far less welcome. On the death of Augustus, A.D. 14, the army of Germany, which Germanicus commanded at the time, broke out into mutiny and offered to elect him emperor, an offer which he nobly refused. He continued the campaign he had begun against the Germans, and brought it to a very satisfactory conclusion; among other feats succeeding in giving honourable burial to the bones of the legions which Varus had some years before so wantonly sacrificed before the patriotic onslaught of Arminius. At last the German chieftain made the country unsafe for Germanicus also, and he withdrew his army safely after some considerable danger, carrying prisoner Thusnilda, the wife of Arminius, in triumph to Rome. Backed by a fleet of 1000 vessels Germanicus returned to the attack of his noble foe, who by the way had learnt his generalship while serving as a young man in the Roman armies, and fought two great battles in North Germany. His arms were now so victorious that Germany bade fair to become a second Gaul in the hands of the Romans. The Emperor Tiberius, who had never forgiven the demonstration of two years before, became alarmed at this new Cæsar, who carried all before him and was adored by his troops; and fearing lest his nephew might supplant him he suddenly recalled Germanicus to Rome, A.D. 17. Germany was in this way lost to Rome for ever, just as the cup was at her very lips. Germanicus married the noble Agrippina, model of a Roman matron, and with her went obediently to his new command in the East. Cnæus Piso, governor of Syria, was secretly in close communication with Tiberius, and had orders to thwart Germanicus in every way. Nevertheless brilliant success awaited him, Armenia was tranquillized, and Egypt was in course of settlement when the prince fell a victim at Epidaphnæ to a sudden illness (A.D. 19). Among the ancients the belief was practically universal that Piso, having failed in all his designs, had received orders from Rome to poison the people's favourite. To save himself the emperor was obliged (whether hypocritically or sincerely) to profess horror at Piso's crime, and issued orders for his immediate execution. Agrippina bore him nine children, among them Caius (Caligula), the successor of Tiberius in the empire, and the infamous Agrippina the Younger, mother of the still more infamous Nero, the last emperor of the Cæsars.

GERMANS, ST., a market-town of England, in the county of Cornwall, situated on the River Tidi, which unites with the Lynher, forming the St. Germans River, on the southern coast. It is 9 miles west of Plymouth, and 256 from London by the Great-western Railway. It is situated on the slope of a tolerably high hill, which rises on the north side of it. The inhabitants of the parish derive their chief support from agriculture and fishing. St. Germans was at a remote period the seat of a bishopric, which was afterwards united with that of Crediton, and from this union arose the see of Exeter. There was a priory here, which was suppressed in the reign of Henry VIII. The conventual church, now used as the parish church, was formerly much more extensive. The church now consists of a nave and two aisles. The architecture is chiefly Norman. St. Germans was formerly a parliamentary borough, but was disfranchised by the Reform Bill of 1832. The population in 1881 was 2301.

GERMANY is the English name for the country called by its own inhabitants *Deutschland*, and by the French *l'Allemagne*. We formerly used the word Dutch as synonymous with Teutonic, but it has now for centuries been limited to what should properly be called the Low-Dutch division of the Dutch people, and to only one nation of that division, namely, that inhabiting Holland. *Platt Deutsch* and *Hoch Deutsch* are divisions clearly recognizable in every way, the Low Dutch being characteristically different from the High Dutch in the main features of their country, their race, their language, and their manners and institutions. Englishmen are Low Dutch by origin. Both divisions are purely Teutonic, and the whole centre of Europe is held by these kindred races, with the one exception of the aristocracy of Hungary, the Magyars, who are a Turanian race, kinsmen of the Turks. Of the titles given to the country their own name, *Dutch* (*Theotisc*), means "the people;" *German*, the name given by the Romans, comes from the tribe of the Germani (who were not Teutons at all, but Celts, though the Romans knew no better); and *l'Allemagne*, the French title, is from the name of another tribe, this time truly Teutonic, the Alemanni. The Alemanni were, in fact, rather a group of tribes than a single tribe, and in the third century held all the country between the Danube and the Main, whence they so harried the Romans that their name came to stand for the entire race.

Area and Population.—Germany occupies the whole of the centre of Europe except Bohemia and Russian Poland. It extends from 5° 50′ to 22° 50′ E. lon., and from 47° 17′ to 55° 55′ N. lat.; its extreme points being respectively, west, Waldfeucht, a village 22 miles N.N.W. of Aix-la-Chapelle, and also the westernmost corner of Lothringen (Lorraine); east, the village of Schirwindt, 36 miles W.S.W. of Tilsit in East Prussia; south, Stillach, at the source of the river Iller in Swabia; and north, Nimmersatt, 14 miles N. of Memel in East Prussia. Or we may say it extends from the Ems and the Rhine (except the lowest portions) to the Prosna and the lower Niemen, and from the Alps and the Erz Mountains (Saxon Switzerland) to the North Sea and the Baltic. From east to west it bears much the same character, but it has a threefold aspect from south to north. Beginning amid the wildest mountain scenery, it has more to the north a pleasantly hilly district, while the main portion (the northernmost) is part of the great European plain; rather narrower to the west, where Minden marks its southern boundary, than to the east, where it takes in almost all Saxony. The watershed of the Danube slopes westward, the rest of Germany slopes north; and the great rivers, the Rhine, Ems, Weser, Elbe, Oder, Vistula, and Niemen, all flow into the northern seas.

The following table gives the area and population of the twenty-five states of Germany in the order of their areas, and of the Reichsland of Elsass-Lothringen, as returned at the two census enumerations taken 1st December, 1875, and 1st December, 1880:—

States of the Empire.	Area, English sq. miles.	Population, 1st December, 1875	Population, 1st December, 1880.
1. Prussia, . .	137,066	25,742,404	27,279,111
2. Bavaria, . .	29,292	5,022,390	5,284,778
3. Wurtemberg, .	7,675	1,881,505	1,971,118
4. Saxony, . .	6,777	2,760,586	2,972,805
5. Baden, . . .	5,351	1,507,179	1,570,254
6. Mecklenburg-Schwerin, .	4,834	553,785	577,055
7. Hesse, . . .	2,866	884,218	936,340
8. Oldenburg, .	2,417	319,314	337,478
9. Brunswick, .	1,526	327,493	349,367
10. Saxe-Weimar,	1,421	292,933	309,577
11. Mecklenburg-Strelitz, .	997	95,673	100,269
12. Saxe-Meiningen,	933	194,494	207,075
13. Anhalt, . .	869	213,565	232,592
14. Saxe-Coburg,	816	182,599	194,716
15. Saxe-Altenburg,	509	145,844	155,036
16. Waldeck, . .	466	54,743	56,522
17. Lippe, . . .	415	112,452	120,246
18. Schwarz-Rudolstadt, .	340	76,676	80,296
19. Schwarz-Sondershausen,	318	67,480	71,107
20. Reuss-Schleiz,	297	92,375	101,330
21. Schaumburg-Lippe, . .	212	33,133	35,374
22. Reuss-Greiz, .	148	46,985	50,782
23. Hamburg, . .	148	388,618	453,869
24. Lübeck, . .	127	56,912	63,571
25. Bremen, . .	98	142,200	156,723
Elsass-Lothringen, . .	5,580	1,531,804	1,566,670
Total, .	212,083	42,727,360	45,234,061

At the census of 1880 the number of males was 22,185,433, and the number of females 23,048,628, being an excess of 863,195 females over males in the total population of the empire.

The average density of the population is 213 per square mile; excluding Hamburg it is greatest in Saxony, where it reaches 438 per square mile, and least in Mecklenburg-Strelitz, where it is 100 per square mile. Of the total population 41·4 per cent. live in towns of 2000 inhabitants and above, and the remainder in rural communes.

The population of Germany was 23,103,211 in 1816, at the end of the wars against France, and thirty years after, in 1837, it had risen to 30,010,711, representing an average annual increase of nearly 1½ per cent. At the census of 1853 the population of Germany was found to be 35,334,538, showing an average annual increase of little more than ¾ per cent.; while the return of the census of 1867, the last preceding the late war against France, gave a total of 38,495,926 souls, amounting to an average annual increase of ⅞ per cent. From the census of 1867 to that of 1871, the war intervening, the increase was only at the rate of 0·58 per annum; but from 1871 to 1875 it rose to 1·01 per cent. per annum; and from 1875 to 1880 to 1·14 per cent.

The bulk of the German population is Teutonic, but in the Prussian provinces of Posen, Silesia, West and East Prussia, are 2,454,000 Slavs (Poles); who, with 2,800,000 Walloons and French, 150,000 Lithuanians, 140,000 Danes, and about the same number of Wends, Moravians,

and Bohemians, make up 3,205,000 non-Germanic inhabitants—7 per cent. of the total population.

The preponderance of the leading state of the empire is very remarkable, the population of Prussia amounting to [illegible]000,000 out of the 45,000,000. In other words, the population of Prussia exceeds the population of all the other German states added together by 9,000,000. It is undoubtedly this circumstance which gives stability to the empire. Prussia so outweighs all the other states together by her immensely large population, her greater wealth, her unity, and her higher organization, that resistance on their part would be certain to be hopeless, except they were supported by a coalition such as that against which Frederick the Great had to contend at the beginning of the Seven Years' War.

The following table shows the number and density of the population of Germany when compared with that of other countries:—

	Population.	Area in sq. kilom.	Number of Inhabitants to each sq. kilom.
Germany, ...	45,234,061	540,522	83·7
Austria-Hungary, .	37,825,889	624,239	60·7
Italy, ...	28,452,639	296,305	96·0
France, ...	37,321,186	528,572	70·6
The United Kingdom,	35,246,562	314,951	111·9
The United States of America, . .	50,152,866	7,598,389	6·6

Constitution and Government.—The present empire of Germany is composed of the following twenty-six states:—

States of the Empire.	Number of members in Bundesrath.	Number of deputies in Reichstag.
Kingdom of Prussia, ...	17	236
" Bavaria, ...	6	48
" Würtemberg, . . .	4	17
" Saxony, ...	4	23
Grand-duchy of Baden, . . .	3	14
" Mecklenburg-Schwerin, . .	2	6
" Hesse, . . .	3	9
" Oldenburg, . .	1	3
" Saxe-Weimar, .	1	3
" Mecklenburg-Strelitz, . .	1	1
Duchy of Brunswick, ...	2	3
" Saxe-Meiningen, . .	1	2
" Anhalt, ...	1	2
" Saxe-Coburg-Gotha, .	1	2
" Saxe-Altenburg, . .	1	1
Principality of Waldeck, . . .	1	1
" Lippe-Detmold, .	1	1
" Schwarzburg-Rudolstadt, . .	1	1
" Schwarzburg-Sondershausen,	1	1
" Reuss-Schleiz, .	1	1
" Schaumburg-Lippe,	1	1
" Reuss-Greiz, . .	1	1
Free town of Hamburg, . . .	1	3
" " Lübeck, ...	1	1
" " Bremen, ...	1	1
Reichsland of Elsass-Lothringen,	4	15
Total, ...	62	397

The Bundesrath represents the individual states of Germany, and the Reichstag the German nation. The members of the Bundesrath are appointed by the governments of the individual states for each session, while the members of the Reichstag are elected by universal suffrage and ballot for the term of three years.

The present constitution dates from the termination of the Franco-German War of 1870–71, the position of Elsass-Lothringen (Alsace-Lorraine) dating from 1874. Its separation from France took place in May, 1871. The invitation to become emperor over all Germany, except Austria, was offered to the King of Prussia at Versailles, 17th December, 1870, and his acceptance and proclamation were given at the same place on 18th January, 1871. The settlement of the constitution was not long delayed. Its date is 16th April, 1871. It has made Germany stronger than ever she has been since the days of Otto the Great and Henry III. By its terms, all the states of Germany "form an eternal union for the protection of the Confederation and the care of the welfare of the German people." The supreme direction of the military and political affairs of the empire is vested in the King of Prussia, who, as such, bears the title of *Deutscher Kaiser*. According to article eleven of the constitution, "the kaiser represents the empire internationally," and can declare war, if defensive, and make peace, as well as enter into treaties with other nations, and appoint and receive ambassadors. To declare war, if not merely defensive, the kaiser must have the consent of the Bundesrath, or Federal Council, in which body, together with the Reichstag, or Diet of the Realm, are vested the legislative functions of the empire. Both the Bundesrath and the Reichstag meet in annual session, convoked by the kaiser. The kaiser has the right to prorogue and dissolve the Reichstag, but the prorogation must not exceed sixty days; while in case of dissolution new elections have to take place within sixty days, and a new session has to open within ninety days. All laws of the empire must receive the votes of an absolute majority of the Bundesrath and the Reichstag. The Bundesrath is presided over by the *reichskanzler*, or chancellor of the empire, appointed by the kaiser, but the president of the Reichstag is elected by the deputies. The payment of any salary, or compensation for expenses, to the deputies is forbidden by article thirty-two of the constitution.

The laws of the empire passed by the Bundesrath and the Reichstag, to take effect, must receive the assent of the kaiser, and be countersigned when promulgated by the chancellor of the empire. The latter, in his capacity as president of the Bundesrath, has the right to be present at the deliberations of the Reichstag. But the chancellor and other officers of the executive are not responsible for their actions either to the Federal Council or the Diet of the Realm, but only to the emperor.

Acting under the direction of the chancellor of the empire, the Bundesrath, in addition to its legislative functions, represents also a supreme administrative and consultative board. It prepares bills, and issues such supplementary provisions as may be required to insure the enforcement of the federal laws. The better to superintend the administrative business of the empire, the Bundesrath divides itself into eight standing committees, respectively for army and naval matters; tariff, excise, and taxes; trade and commerce; railways, posts, and telegraphs; civil and criminal law; and financial accounts and foreign affairs. Each committee consists of representatives of at least four states of the empire; but the foreign affairs' committee includes only the representatives of the kingdoms of Prussia, Bavaria, Saxony, and Würtemberg.

Revenue and Expenditure.—The common expenditure of the empire is defrayed, according to article seventy of the constitution, from the revenues arising from customs, certain branches of excise, and the profits of the posts and

telegraphs. Should the receipts from these various sources of income not be sufficient to cover the expenditure, the individual states of Germany may be assessed to make up the deficit, each state being made contributory in proportion to its population.

The question of biennial budgets, which had been long pending between the government and the Reichstag, resulted in a victory for the former in 1883. The total revenue and expenditure for 1884-85 were each estimated at £29,540,967. Of the expenditure £17,000,000 was for the army. The chief source of revenue is customs and excise, which yield together about £18,000,000 per annum. The year 1876 was the first in which the imperial accounts were kept in the new money denomination, the mark, a coin of the exchangeable value of 1*s*. British money. In addition to the common outlay, there are the budgets of the various states, which may be set down as altogether about twice the sum of the imperial budget.

At the end of 1870 the Confederation had contracted a public debt of 220,000,000 thalers, or £33,000,000, incurred for extraordinary expenditure on account of the army and navy, not provided for in the budget. By the addition of other loans, the total liabilities of the German Empire amounted to 340,000,000 thalers, or £51,000,000, at the end of 1871. The whole of these liabilities were met in 1873 from the indemnity exacted from France, so that the establishment of the German Empire presents the rare instance of an immense political reform accomplished not only without any additional burden being imposed upon the people, but actually removing that which previously existed. A public debt has, however, since been created, and now amounts to £20,000,000.

The sums received from France as war indemnity under treaty of 26th February, 1871, were placed to a separate account. The whole total was received by the end of September, 1873, and amounted to 1,486,500,000 thalers, or nearly £220,000,000. This included, besides the treaty indemnity, war contributions levied in some of the French departments, a sum of £6,000,000 from Paris, and interest. Nearly 87,000,000 thalers were paid to France for the Elsass-Lothringen railways, 42,000,000 thalers to private persons and corporations in Germany and Elsass for damages and expenses during the war, 24,000,000 thalers for railway repairs and stock, chiefly in Elsass-Lothringen. A sum of 240,000,000 thalers was set apart for invalid pensions, in addition to an invalid fund of 27,000,000 thalers. The Reichsland fortresses absorbed 40,000,000 thalers; new military and naval material, 28,000,000 thalers; extra expenses of war occupation, 29,000,000 thalers; reimbursement to custom-house department, 20,000,000 thalers; endowments to generals, 4,000,000 thalers; purchase of gold for new coinage, 25,000,000 thalers; war reserve fund, 40,000,000 thalers. After supplying the imperial treasury with working capital and re-equipping some special branches of the military service, the remainder was distributed among the various states.

Army and Navy.—By the constitution of 16th April, 1871, the Prussian obligation to serve in the army is extended to the whole empire, it being enacted by article fifty-seven, that "every German is liable to serve—*wehrpflichtig*—and no substitution is allowed." By the Army Bill the Prussian military legislation is applied to all the states of the empire. The average annual number of young men actually drawn for the ordinary conditions of service in the army is 160,000, besides 5000 who enter as volunteers for one year, and 5000 for the marine. The superior importance of the army as compared with the navy is significantly shown by their relative cost, that of the army being £16,000,000, and of the navy only £2,000,000 per annum.

The sixty-third article of the constitution of 1871 enacts "the whole of the land forces of the empire shall form a united army, in war and peace, under the orders of the kaiser." The sovereigns of the principal states have the right to select the lower grades of officers; and the King of Bavaria reserved to himself the special privilege of superintending the general administration of that portion of the German army raised within his dominions. But the approval of the kaiser must be obtained to all appointments, and nothing affecting the superior direction of the troops of any state of the empire can be done without his consent. It is enacted by article sixty-four of the constitution of 1871 that "all German troops are bound to obey unconditionally the orders of the kaiser, and must swear accordingly the oath of fidelity."

The union of the North German and South German contingents, and the extension of the Prussian landwehr system to South Germany, make the German army the most numerous, as it is the best organized, that the world has ever seen.

The following table shows the strength and organization of the imperial army on the peace-footing in 1884:—

Peace-footing.	Officers.	Rank and File.	Horses.	Guns.
Infantry, 161 regts.,	9,529	278,822	—	—
Jäger, 20 battalions,	424	11,120	—	—
Landwehr Depots, 275 battalions, .	326	4,764		
Total infantry, . .	10,279	294,706		
Cavalry, 93 regts., .	2,358	64,699	62,550	—
Field Artillery, 37 regiments, . . .	1,801	84,817	16,591	1,374
Fortress Artillery, 14 regiments and 3 battalions, . . .	729	16,349	—	
Engineers, 20 battalions, including 1 railway battalion,	406	10,840	—	—
Train, 18 battalions,	200	4,905	2,457	—
Staff division, . . .	2,032	4	—	—
Special services, . .	313	954	—	—
Total, . . .	18,118	427,274	81,598	1,374

There are in addition 8847 military and veterinary surgeons, gunsmiths, paymasters, &c., making the total force of the German army in peace 449,239 officers and men. The war strength of the army is more than treble this number, being raised to 35,400 officers, 1,500,000 men, 312,000 horses, and 2500 guns. The railway and telegraph service alone, in war, numbers 1238 officers, 7000 men, and 5400 horses. If to these numbers we add the Landsturm and the one-year volunteers, the total war strength of trained soldiers would be about 2,650,000.

The mass of soldiers thus raised is divided into companies, battalions, regiments, and corps d'armée. The strength of an ordinary battalion in peace is 544 men, raised in war to 1002 by calling in part of the reserves; it is divided into four companies, each of which in war consists of 250 men. Excepted from this general rule are the battalions of the guards and the regiments in garrison in the Reichsland of Elsass-Lothringen, the strength of which on the peace footing is 686 men. During peace each regiment of infantry consists of three battalions; each brigade, of two regiments; each infantry division, of two brigades, to which, under the command of the divisional general, four squadrons of cavalry, four batteries of artillery, each of six guns, and either a battalion of riflemen or a battalion of pioneers are attached. The corps d'armée is

considered a unit which is independent in itself, and includes not only troops of all three arms, but a portion of all the stores and appliances which are required by a whole army. Each corps d'armée consists of two divisions of infantry, a cavalry division of four regiments, with two horse-artillery batteries attached, besides the two cavalry regiments attached to the infantry divisions, and a reserve of artillery of six field batteries and one mounted battery. There is, moreover, attached to each corps d'armée one battalion of pioneers and one of military train.

The corps d'armée are locally distributed throughout the empire-monarchy, with the exception of the corps of the guards. There are (besides the Prussian corps of the guards) seventeen corps d'armée, the first eleven of which are named after Prussian provinces, and the remaining six after states of the empire. They are:—1, Prussia; 2, Pomerania; 3, Brandenburg; 4, Saxony; 5, Posen; 6, Silesia; 7, Westphalia; 8, Rhineland; 9, Schleswig-Holstein; 10, Hanover; 11, Hesse-Nassau; 12, Saxony; 13, Würtemberg; 14, Baden; 15, Elsass-Lothringen; 16 and 17, Bavaria.

Since the Franco-German War the fortress system of Germany has been entirely remodelled, a number of old fortified places deemed useless have been abolished, many new ones erected, and others enlarged. There are now seventeen fortified places of the first class, and twenty-six other fortresses.

To show the completeness with which everything connected with the army is attended to in Germany, it may be stated that a complete railway service is provided, the men belonging to which are qualified both for the construction of railways and for driving trains, &c. In order to qualify the men thoroughly for their duties, part of one of the Prussian lines is always entirely worked by these railway battalions.

In order to be prepared for any emergency, a war fund (*kriegschatz*) of 120,000,000 marks, or £6,000,000, has been set aside, and is not to be touched under any circumstances, except at the outbreak of war. A similar fund had long existed in Prussia, and was found of great service at the commencement of the war with France in 1870.

The formation of a German navy, due to the initiative of Prussia, dates from 1848, and rapid progress has been made in it during the last few years. In 1884 the navy consisted of twenty-four ironclads, seven frigates, six despatch boats, eleven gunboats, and four sailing vessels. After the war of 1870-71 it was proposed that the force should be at once very largely increased, but the proposal was objected to by the government, who contended that being so strong by land Germany must be content to be a second-rate naval power. When the proposed constructions were realized, she would be in a position to carry on offensive operations against any maritime power, with the exception of the three or four leading navies of the world. The number of ironclads is increasing; they are among the most powerful of any navy in the world, and in a naval engagement would prove extremely formidable. Great reliance, especially for defensive purposes, is placed upon the torpedo system.

The sailors for the German navy are drawn from the seafaring population in the same manner as the army is from the inland population, the term of service being for three years. There are four classes. The first class, from which the petty officers are found, comes from a naval school, the pupils of which enter as boys, and are taught seamanship in youth. The term of service of this class is twelve years, after which they are provided for in various capacities in the civil services of the crown. Young men from the inland districts are allowed to acquit themselves of their military liabilities by a four years' service on board ship. Germany has four naval ports—Kiel, Dantzig, and Stralsund on the Baltic, and Wilhelmshaven in the Bay of Jahde, on the North Sea.

Religion and Education.—The German Empire, according to the last census, comprises 28,300,000 Protestants, 16,200,000 Roman Catholics, 100,000 of various other Christian sects, and 560,000 Jews. In North Germany about 70 per cent. of the population are Protestants and 26 per cent. Roman Catholics; while in South Germany, on the other hand, over 70 per cent. of the inhabitants are Roman Catholics.

Education is more generally diffused throughout Germany than in any other part of Europe, and is promoted with great earnestness and devotion. There are twenty-one universities, of which fourteen are Protestant, and innumerable special and general schools, at the latter of which the attendance of children is made compulsory for at least four or five years by nearly all the states of the confederation; hence the proportion of persons who cannot at least read and write is exceedingly small.

General Condition of the People.—German workmen almost all possess more or less culture and instruction. And in respect of educational advantages, especially of a technical kind, their interest is promoted in every way. Schools are provided by government both for children and for workmen; those for the latter are, of course, so constituted as to advance the different industries, whether scientific or artistic. There is hardly any class of industrial art which is not pursued in Germany—linen, silk, and cotton factories, mines, iron and coal works, potteries, the manufacture of arms, watches, locks, jewelry, agate cutting, &c.

The hours of labour are very long, often eleven exclusive of meals. Jacobi states that they reach thirteen and sixteen hours per diem in certain manufactories. The short hours and school attendance compulsory on all young persons in Prussia indirectly counteract, or at least limit, the injurious effect of this; but it nevertheless remains as a bad feature in the condition of the working classes in Germany. The food principally consumed by the working people consists of rye-bread, dumplings, sausage, soups, cabbages (of which there is a great variety), pork, veal, mutton, porridge, and beer and coffee in large quantities. A considerable amount of corn brandy is also drunk; it is very cheap, but bad and fiery. If, however, the Englishman's food costs twice as much as the German's from the quantity and the quality of the meat which he insists on having, as well as his wasteful mode of dressing it, the German, in point of the frequency of his meals and the quantity eaten, distances every nation in Europe. The dietary given for the ordinary Saxon artisan in towns comprises a repast every three hours, and is as follows:—Six a.m., three cups of coffee with white bread; nine a.m., more bread, butter, cheese, and brandy; twelve, soup, with meat and vegetables in it, and beer; four p.m., bread, butter, cheese, with either coffee or brandy; seven p.m., bread, with sausage or cheese and beer. Sometimes stewed or baked meat is eaten at twelve instead of soup. The diet in the country villages is, perhaps, a little lower in quality; but it is, at all events, ample in quantity, and contains a fair amount of nitrogenous matter. As compared with Englishmen the Germans are large and indiscriminate feeders, and compared with French workmen their gastronomic tastes are gross and unrefined.

In such a large country the price and quality of houses vary considerably, but on the whole there is a very fair standard of comfort maintained, and in several states the laws are so stringent with regard to ventilation and drainage that epidemics are exceedingly rare. It is really surprising, and, considering his low wages, very creditable to the German workman, that he so often contrives to become the owner of the house he lives in. The amusements of the working classes are cheap and numerous, and

in great variety. They are also, in some instances, of an elevating kind. The taste for theatrical entertainments, and also for good concerts and picture galleries, is very strongly developed. To these the majority of the men bring a cultivated eye, taste, and voice. They can mostly sing in parts, and play on at least one instrument. Many of them are well read in the classics of their own language, and some discuss Shakspeare's works with intelligence and knowledge. Then, again, there are the tea or beer gardens, where the women knit and the men smoke over their beer, dancing and music go on, and all retire sober and quiet by ten o'clock. Education is, as we have seen, far advanced; it is everywhere good, excessively cheap, and, if necessary, gratuitous. Besides the primary, technical, and polytechnic schools, there are *fortbildungsschulen*, which are schools for the further education of the young artisans after they have passed the period of compulsory attendance at the primary schools; in these regard is had to the future industrial career of each pupil.

The provisions which, as provided by law, affect German employers, workmen, and artisans, are so numerous and stringent, that to Englishmen the system seems open to the charge of being over-regulated. It applies not only to contracts, wages, disputes, strikes, hours of labour with regard to children—matters which we are accustomed to legislate on—but to the health, deportment, morals, and education of apprentices and journeymen, the prices of certain articles, the charges in hotels, adulteration, short weights, and so on. The truck system is effectually prevented by providing that employers can neither sue for the value of goods which they have supplied to operatives, nor repay themselves by deducting the amount from the workman's regular wages.

The enormous and sudden inflation of the capital and trade of Germany soon after the conclusion of the Franco-German War was by no means productive of permanent advantage to the industries of the country. A large number of laws were enacted with the view of freeing the commercial and social life of the nation from restraints by which it was formerly bound, and as these alterations coincided with a period of commercial prosperity all over the world, great commotion was occasioned in every part of the land. The lower classes, more especially, were seized by a vehement desire to better themselves. With the law no longer impeding their movements, and capitalists steadily demanding hands, journeyman labourers suddenly found it possible to exact high wages and adopt a more liberal style of life. For a year or two immense wages were granted—a man, for instance, acting as bricklayer's labourer in Berlin earned in 1872 as much as 15*s*. per day. The rise in the price of rent and provisions consequent upon this, in due time drew the middle classes into the vortex, making increased income a necessity, and inducing speculation and enterprise where they were formerly shunned.

Agriculture, Manufactures, Internal Communication, Trade, and Commerce.—Agriculture is elevated to the rank of a science. It embraces the growth of rye for bread to a much greater extent than of wheat. All the ordinary European cereals are cultivated in the north and exported; and hemp, flax, madder, woad, and saffron grow well in the central districts. The cultivation of the vine is brought to great perfection, and extends as far north as 51°; while tobacco, hops, and fruits of all kinds are also grown in considerable quantities. The horses and sheep of Germany have long been noted. The rich alluvial soils of Mecklenburg and Hanover are celebrated for their cattle, and Central Germany abounds in swine.

The internal communications are in a highly efficient condition, by means of an extensive system of railways and rivers susceptible of steam navigation.

There are extensive linen, cotton, and woollen manufactures; and the glass of Bohemia and Silesia, and the china and earthenware of Saxony and Prussia, stand pre-eminent. There are also important manufactories of steel and iron, jewelry, philosophical instruments, &c.; and the peasants in many districts employ their leisure hours in making toys, wooden clocks, and wood carvings, which may be almost regarded as a peculiar product of German industry. The chief exports of Germany are linen, woollen cloth, wool, grain, seeds, wooden goods, toys, glass and earthenware, leather, bristles, honey, wax, wine, spirits, zinc, potash, cobalt, gypsum, vitriol, and manufactures of copper, brass, iron, and steel. The principal imports are raw cotton, silk, sugar, rice, tea, spices, furs, pitch, oil, fish, &c.

Before the establishment of the Zollverein, or Customs' League, the various states of the Confederation were completely isolated in all commercial matters, each having its own line of custom-houses, tariff of duties, and in most cases its own coins, weights, and measures. The first step towards the establishment of the Zollverein was taken in the year 1828, when, by special treaties, the grand-duchy of Hesse and the duchy of Anhalt were brought within the customs limits of Prussia. In 1829 the two Saxon duchies of Meiningen and Coburg-Gotha were induced to join the Zollverein; and four years after, in 1833, its boundaries were vastly enlarged by the entrance into it of the kingdoms of Bavaria, Würtemberg, and Saxony. During the next thirty years all the states of Germany, except the two duchies of Mecklenburg and the three free cities of Hamburg, Lübeck, and Bremen, were brought into the great commercial union. The two Mecklenburg duchies, together with Lübeck, acceded to it on September 1, 1868; so that now it includes the whole of Germany, except the two cities of Hamburg and Bremen.

The administration of the Zollverein is carried on by delegates of the various states composing it, with a central government at Berlin. All the receipts are paid into a common exchequer, and distributed, *pro rata* of population, among the members of the league.

In 1872 the new uniform decimal (French) system of weights and measures, and in 1876 the new German gold currency, were introduced for all German states. The trade between the United Kingdom and Germany in recent years was as follows:—

	Exports of British and Irish Produce to Germany.	Imports from Germany.
1881, ...	£17,431,439 ...	£23,646,610
1882, ...	18,518,024 ...	25,806,302
1883, ...	18,791,439 ...	27,918,078

HISTORY.—The history of the several states of Germany is only equalled in intricacy by that of the republics of Italy, but the main stream of its fortunes is bound up with, (1) the struggles against the masters of the ancient world—the Romans; and (2) the "Holy Roman (that is, the German) Empire," founded by Charlemagne and destroyed by Bonaparte. It is impossible to find anything in historical study more valuable or more interesting than this long career; for the central position of the kingdom and its curious elective character bring it constantly into connection or conflict with all European states, and its pre-eminence of rank among them causes it through the ages to be perpetually at strife with the spiritual empire wielded by the bishops of Rome. The ideal or dream of two masters for the world—the spiritual and the temporal—nowhere better told than in the magnificent soliloquy of Charles V. in Victor Hugo's drama of "Hernani," was never actually realized. Indeed perhaps it is almost superfluous to say so. But the constant and mistaken striving after this ideal, and especially the contest as to which of the two was to have the supremacy over the other,

prevented Europe from making real progress almost down to our own century. It is indeed not too much to say that for over eight centuries, or for nine centuries if we reckon from Otto the Great, Germany was never united in any national combined effort till the war against France in 1870 drew her several states into the friendship and mutual respect begotten of many warlike hardships and triumphs shared in common. Even as yet Austria is held aloof, but it must be remembered that only part of Austria is truly German. We have briefly to trace this chequered course of the great Teutonic race.

When we first read of Germany in the Latin historians it is a wild place, full of forests and marshes, haunted by wild beasts, and by barbarians scarcely less fierce than they. Many tribes existed, and frequently they would join in a sort of union. Tacitus (A.D. 92) speaks of three such great unions or nations of Germans in his time. They extended but little westward of the Rhine. Julius Cæsar had found them tentatively pressing upon Gaul, however, under the guidance of Ariovistus, a Suevic king. Suevi was a general name for tribes dwelling between the upper Danube and the Baltic. Cæsar drove them back from Gaul; and to make sure, crossed the Rhine after them (55 B.C.) on a famous temporary wooden bridge, the engineering of which was no mean proof of his military skill. Quiet, or comparative quiet, now reigned till the time of Augustus, who sent his stepson Drusus, brother of Tiberius, to repress some outbreaks. Drusus succeeded so well that he hoped to make Germany a new Gaul for orderliness. In the year 9 B.C. he conquered the fierce Chatti and the Marcomanni, and penetrated to the upper Elbe. He explored the coasts of the northern seas, made bridges, forts, and roads, and cut a canal between the Rhine and the Yssel. Had he lived he would have altered the fate of Germany. His work was continued by Tiberius (not yet emperor), who sent away 40,000 of the most turbulent Germans into what we now call Holland, to separate them from the rest. But P. Quinctilius Varus, who next succeeded in command, attempted too soon to rival Cæsar's career in Gaul sixty years before, and to introduce the full Roman polity. Arminius (? Hermann), a young chief of the Cherusci, a tribe having the Harz Mountains as their centre, who had himself served as an officer in the Roman legions (and was moreover a Roman citizen of the equestrian order), with consummate secrecy organized a great revolt. Varus was in constant and friendly communication with Arminius, who by skilful alarms caused him to gather all the Roman force, and move forward on the Teutoburg wood (near the modern Lippe), a forest still bearing its ancient name. Once among the ravines Varus was fallen upon by the Germans. Hardly a man escaped from the furious three days' massacre. Varus fell on his own sword in misery (A.D. 10). The aged emperor Augustus tore his clothes with grief and rage, crying, "Varus, give me back my legions!" for he saw at once that Rome had no power over a people that could organize such a revolt. Germany at this one blow was free, and though Germanicus, the son of Drusus, undertook some brilliant campaigns there, he could do nothing permanently save to retrieve the Roman honour by burying the dead of Varus, whose bones had for five years whitened the ground.

The Germans lay quiet for a long time; but eventually they became the aggressors, and in the second century harassed the Roman state terribly from the north, especially in the sanguinary wars against the good Emperor Marcus Aurelius, waged by the Marcomanni, who lay between the Rhine and the Danube, and their eastward neighbours the Quadi.

Here it will be well to notice a few main points running through the organization of the German tribes. They were men of tall stature, fair, with yellow or reddish hair, of immense strength and indomitable energy, impatient of the yoke, fierce and cruel, but truthful, simple, and hospitable. They were fond of music and their wild national epics. They were an agricultural people, but the actual field work was done mostly by women and slaves. The men were warriors. The Germans lived in isolated families, each hut or cluster of huts surrounded with its own ground; and the association of such families formed the village. A number of villages made the *hundred*, probably so called from sending a hundred warriors to the army. A large division made up of hundreds was the *gau*. The head of the family was as absolutely chief as the Roman *paterfamilias*—even the death-power was his. These free men (one of their great associations was called by no other name than "the free men," or *Franks*) ruled themselves, all having equal rights. Officers were elected from certain families (the *eorls* of the English), who from some reason now not traceable were held to be noble, but who had few other special rights. Beyond the eorls, the freemen (called *ceorls* among the English, a people living near the mouth of the Elbe), and the slaves, were a fourth class, the *liti*, somewhat akin to the *plebs* of early Rome, free but landless, and without share in the government. The local chief, or the king of the tribe, once elected was faithfully followed, but only as *primus inter pares*. The king had little kingly authority, and only so much state as was gained by a small personal following of chiefs, whom Tacitus dignifies by the title of princes. The real government lay in the meetings of the tribe, which all freemen attended. Decisions upon the points laid before the meeting by the chiefs were absolute; men shouted their disapproval or joyfully signified their assent by clashing loudly their spear upon their shield. For weapons they preferred the spear, the mace, or the great axe to the sword. Their religion was so nearly that of the NORSE MYTHOLOGY of the Eddas that it needs no further consideration here. These German tribes worshipped in the forests, used divination and auspices, and were in a great measure their own priests.

Shortly before the fourth century the whole of Germany was in the greatest confusion. About the year 300 the Goths held all Eastern Europe, spreading out from their original seat on the Vistula. Their king, Ermenrich, was so so powerful that later he was held to be an emperor, and is credited in the ancient legends about Dietrich of Bera, &c., with wars in Italy and elsewhere in true imperial style. This Gothic kingdom was split in two in the fourth century by the Huns, pushing westward from Asia, first precursors of the Turks. The Ostrogoths or East Goths were conquered by the invaders, but eventually recovered their freedom, and under Theodoric rose to great power in Italy. The Visigoths or West Goths passed the Danube under their great leader FRITIGERN in the time of the Emperor Valens, and settled long in the northern territories of the Eastern Empire. While the East Goths conquered in Italy, the West Goths attacked the sister peninsula of Spain with like success, occupying also the southern part of Gaul. They had been preceded in Spain by the Vandals, who originally dwelt along the shores of the Baltic. These, with the Burgundians, broke upon Gaul early in the fifth century (about 409), and while the Burgundians remained there to found Burgundy the Vandals overran Spain, and have left their name in (V-)Andalusia there. Passing into Africa, under their fierce king GENSERIC, the Vandals conquered the Roman dominions there; and on their subsequent invasion of Italy the capture and sack of Rome (455) was remembered as the most terrible scourge the city ever sustained. They continued masters of Africa (*i.e.* North Africa) till 535. The Longobards, or Lombards, who in the time of Tacitus dwelt along the Elbe, moved south during this period of restlessness, and were incited by Justinian to attack the Gepidæ in Dacia, whom eventually their king Alboin exterminated.

After this Alboin led his Lombard warriors across the Alps into Italy, and driving the East Goths before them they conquered that fair land of Lombardy which has borne their name ever since. Finally, the Low Dutch tribes began to move, and in the middle of the fifth century the famous invasion of Hengist and Horsa placed Kent in the hands of a Teutonic people, and there begun that slow fierce conquest of Britain from the Celts which ended in the uprising of a new England.

Most of these German states fell as quickly as they rose, but in England and France the conquest was permanent. Both conquests are elsewhere narrated, and in FRANCE the early history of Germany itself is traced. Frank kings ruled it, so far as in those lawless times ruling was possible, up to and including the great Charles himself. Charles the Great was crowned Emperor of the Romans by Leo III. on Christmas Day, 800, in St. Peter's at Rome, and ruled from the North Sea to the Ebro and to Rome, and from the Atlantic to the Oder and the Vistula. His main capital was Aix-la-Chapelle. He governed this vast territory with astonishing vigour and success. All round it he set *marks* or marches, districts where the frontier of the empire *marched* with the countries of the barbarians, and over these he placed his best generals as margraves, *grafs* or counts of the mark. The eastward mark, or Öster-reich (Austria), was destined to become one day familiar to all men. Over each *gau*, or group of hundreds, a count ruled, or if it were imperial territory a palsgrave (graf or count of the palace); and these gaus or counties were grouped to make a duchy, ruled by a duke (Germ. *herzog*). Though at first appointed by the Frankish kings, such counts and dukes had even before Charles the Great's time come to possess hereditary rights to their titles, subject always to their ruling well. At Charles' death in 814 his son Louis succeeded him, and Louis resigned the empire at Aix-la-Chapelle in 817 to his three sons, Lothar, Pippin, and Louis. It is narrated in FRANCE how Lothar, though emperor, came to have only the country called, after him, *Lotharingia* (now Lothringen or Lorraine) and Italy, Charles the Bald taking France, and Louis, or Ludwig the German, Germany. But each of the brothers still called himself King of the Franks. This arrangement was made by the treaty of Verdun in 843, and the history of Germany as a separate kingdom must be taken to start from this point.

The Germany of Ludwig was far from being equal to the eastern part of his grandfather's vast empire. The Elbe and Bohemia, the Rhine, the sea, and the Alps bounded his shrunk dominions. He was harassed, too, by Scandinavian pirates (the Danes of terrified England, the Northmen or Normans of equally terrified France); and these bold sea-warriors were not content with coast plunder, but in light skiffs would penetrate to the heart of the land itself, slaying, burning, and robbing. Thus Hamburg was nearly destroyed in 847. His son, Charles the Fat, succeeded him on his death in 876, and in 884 was elected Emperor of the Romans. He also became regent of France, at that time nominally ruled by a boy-king. But though by intrigue he had thus reunited in one rule what remained of the empire of Charles the Great, he had neither strength nor wisdom to hold it, and his conduct at Paris against the Northmen in 885 was so pusillanimous as to cause his deposition at Tribur in 888. He retired to a monastery, and died soon after his deposition. His brave nephew Arnulf succeeded, and was crowned emperor after a successful siege of Rome in 894. Arnulf's son, Louis the Child, came to the throne in 899, and was all his short reign engaged in a life and death struggle against the Magyars, a Finnish folk now settling in Hungary, with a kindred race from Scythia called the *Ungri* (whence our *Hungary*), pressing him from the eastward. In 910 he was so beaten down that he was forced to pay them tribute, and in 911, worn out by incessant fatigue, he died. As he was childless the Karling empire ceased. He was never crowned emperor.

Merwing Frankish Kings of Gaul and Germany together. See FRANCE.

Karling Frankish Kings [see FRANCE] down to Charles the Great, emperor in 800, died 814. Louis the Pious, emperor, son, 814, died 840; Louis or Ludwig the German, son, 817; Charles the Fat, emperor, son, 876, deposed 888; Arnulf, emperor, nephew, 888; Louis the Child, son, 899, died 911.

This seems the place for a notice of the mediæval German constitution. The old assembly of the people had now quite died out. What had taken its place was the diet of nobles and princes. These latter were now soon to become independent, each living in his frowning stone fortress-palace, usually perched on some almost inaccessible rock, whence, for one of its conveniences, approaching travellers could be descried, and be made to pay black-mail before passing in safety. Neighbouring nobles waged bitter war on one another. Moved by pious feelings each succeeding king or emperor had given lands to the church, until at the close of the Karling period about half Germany was in the hands of the priesthood. These church lands were untaxed, and almost free of imperial supremacy, subject only to the assessed contribution to the army. Of the six archbishoprics those of Mainz (Mayence), Köln (Cologne), and Trier (Treves) were the chief, and when in the thirteenth century the right of electing the emperor had gradually been reduced from the entire diet to seven princes, these dignitaries were three of them, the Archbishop of Mainz being the convener of the electoral college. The four other electors were the Duke of Saxony, the Margrave of Brandenburg, the Palsgrave of Rhineland, and the King of Bohemia. Bavaria was excluded, as being already represented by the palsgrave, the other branch of the same family. These elected the King of Germany, and after some contest with the popes the title of "King of the Romans" was also admitted to be in their gift; but the full title of Emperor of the Holy Roman Empire was only given personally, at Rome, by the pope. This right of coronation, existing from Charles the Great himself onward, and this assumption of succession to the ancient empire of Rome, were the most fatal things possible to Germany. Endless expenditure of blood and treasure in foreign lands to support a shadowy title, endless contests for supremacy with the pope, endless civil discords not only with the priestly half of the empire, but with those whose jealousy or whose interests made them pope's men rather than emperor's men, and as a consequence anarchy and ruin during the long absences of the emperors—such were the evils under which Germany groaned for century after century. Every princelet or robber chief snatched at independence, too, under a weak emperor; till the map of Germany gradually became a hopeless puzzle, and so remained down to almost our own day. It would seem, happily, that these times are for ever past, and that there are hopes of a German national unity growing up, to the great benefit and safety of mankind. As for the common people in these times they lived as they could. In the case of many towns they bought, stole, or intrigued themselves into independence, and became FREE CITIES; those who could not do this were used shamelessly by the nearest noble, who claimed rights over them, in order to extort gold when needed. Out of this crying need arose the HANSEATIC LEAGUE, beginning with a treaty between the powerful free cities of Hamburg and Lübeck in 1241, and rapidly growing to such vast proportions as to absorb nearly all the trade of the world. Branches flourished in our own city of London, and the money of these honourable *Easterling* merchants was so superior to the debased coinage of our own kings that it became the ideal of commerce, and

the purity of the *pound sterling* (Easterling) still remains a national article of faith with us.

The Karling line having died out, the great nobles (not yet reduced to the seven electors) met and elected Conrad of Franconia king. Dying almost on the battlefield, in one of his incessant wars, Conrad had the magnanimity to recommend as his successor Henry of Saxony, whom he felt to be the most capable prince in Germany, were it only through the never-ending contest which he himself had sustained against him. Henry was engaged in hunting with his falcons when the news of his election reached him, and he was named Henry the Fowler from this circumstance. He founded the Saxon dynasty of emperors (918). His first achievement was to drive back the Hungarian Magyars once for all, and his next to seize and annex Lothringen, which remained German till Louis XIV. of France conquered and took it, and which only in our own day (1871) has returned to Germany. With the Danes and the Slavs Henry was almost equally successful. The borders of the empire thus freed he turned to the land itself, and by every means in his power, even by the use of a sort of conscription forcing men to live within walls, he encouraged the growth of towns, over which he appointed imperial *burgraves*, and raised a class of burghers or townsmen which he foresaw would form the only possible means of coping with the insubordination of the nobles. Henry was never able to find time to get to Rome. Otto the Great, son of Henry the Fowler, ascended the throne at his father's death in 936. His fame as a youth had spread into all lands, and he had married the daughter of our King Edward the Elder, son of Alfred the Great. By a series of brilliant statesmanlike measures he secured all the great duchies of the empire in his own hands or in those of his family, and Germany rose under Otto to the greatest power and unity she ever attained in the middle ages. In 951 he entered Italy, and marrying in second nuptials Adelheid of Lombardy, annexed that rich kingdom and took the title of King of Lombardy. Danes and Hungarians he so thoroughly beat in battle on his return into Germany that practically they were never more heard of as enemies. Then going on a second journey into Italy he was crowned emperor at Rome in 962. All succeeding kings of Germany claimed to be kings of Lombardy and emperors of the Romans, and most unhappily it was nearly always the case that these foreign honours and titles were more striven for and more desired than their native kingship over the Germans. Otto the Great died in 673, and was succeeded by his son and grandson Otto II. and III., each of whom spent much time in Italy; in the latter his line died out. Henry II., successor of Otto III., was a kinsman, though not a very close one; he was Duke of Bavaria before his election to the throne of Germany (1002). He was crowned emperor at Rome in 1014. Feeling it necessary to assert the right of the kings of Germany to become emperors, it was Henry II. who adopted the method (which caused much papal demur) of assuming the preparatory title of King of the Romans without coronation at the pope's hands. The literature of this period was all in Latin; the architecture of its churches was Romanesque; in every way its ideal was Latin and Roman.

Period of the Saxon Dynasty.—Conrad (of Franconia) 911; Henry I. (of Saxony) the Fowler, no relation, 918; Otto I., the Great, emperor, son, 936; Otto II., emperor, son, 973; Otto III. (called the Wonder of the World for his school-learning, taught by Gerbert, whom he made pope as Silvester II.), emperor, son, 983; Henry II., duke of Bavaria, "St. Henry," emperor, relative, 1002; died 1024.

On the death of St. Henry (so called by a church grateful for numerous benefits received) the nobles elected Conrad, a count of Franconia and descendant of Otto the Great, as king. He was crowned emperor at Rome in 1027, and founded the fine line of Franconian emperors. His friend, our Canute the Great, was present at the coronation, and Conrad's son married Canute's daughter. Radolf, king of Burgundy, was another friend of Conrad's, and as he was childless he left his kingdom by will to the emperor. Burgundy (the kingdom) thus now fell into the empire (1032), the free county of Burgundy and the duchy of Burgundy still remaining French. [See BURGUNDY.] It was in Conrad II.'s reign that all fiefs were declared hereditary. His son, Henry III., succeeded him in 1039, and ruled so wisely that he was able in 1043 to astonish the world by proclaiming a general peace throughout the empire. It is indeed a moot point whether he or Otto the Great should be considered the greatest of the mediæval emperors. Henry almost stopped for a time the cruel custom of private wars between the nobles. The church helped him in this by the "Truce of God," making private war a sin between every Wednesday evening and the following Monday morning. In one point Henry III. clearly overtops Otto—in his supremacy over the church. He successively raised by his own authority no less than four popes (Germans all) to the papal chair, and this part of his success seems almost to be regretted in view of the terrible results of papal ambition so soon to arise. Henry IV. was only six years old when his father Henry III. died (1056), and to his injudicious training as a youth may be ascribed much that was faulty in his conduct as a ruler. His tyranny, when he wielded power for himself, brought him into severe straits with the Saxons, and still more his imprudent defiance of the pope over the question whether the pope or the king had the right to the allegiance of the clergy, urged too at the very time when he was without support from his offended subjects. How the imperious Hildebrand (Gregory VII.) excommunicated him and forced him, king though he was, to sue humbly for three days barefoot in the courtyard of the Castle of Canossa, in Lombardy, for a remission of the sentence, is known to all. While Henry was absent on this desperate enterprise to save his crown, an attempt was made to depose him. His swift return soon put an end to this, and he was so well seconded by his son-in-law, Frederick of Swabia, that he was soon able to leave the pacification of Germany in Frederick's hands, return as a victor to Italy, and to receive coronation as emperor at the hands of a new pope (1081). Frederick of Swabia, whose castle was perched on the high rock of Staufen, had thus gained the name of *Hohenstaufen*, and it was under his descendants that the empire was to rise to its culmination of splendour, if not of real strength. Henry's sons revolted against him in his old age, and they even forced him to abdicate in 1105. His second son succeeded as Henry V., but in him the Franconian line came to an end. The concordat of Worms in 1122 was the chief event of the reign of Henry V. In this the emperor was allowed the feudal allegiance of the greater clergy, but their appointment and their investiture was left in the hands of the church. Lothar, duke of Saxony, succeeded Henry, but it was only after a violent and almost successful armed opposition raised by the Hohenstaufen princes, descendants of Frederick of Swabia.

Period of the Franconian Dynasty.—Conrad, a Franconian count, emperor, 1024; Henry III., emperor, son, 1039; Henry IV., emperor, son, 1056, deposed 1105; Henry V., emperor, son, 1106; Lothar of Saxony, no relation, 1125, died childless, 1137.

Conrad, duke of Franconia, son of Frederick of Swabia (the Hohenstaufen), was elected successor to Lothar, 1138. Henry the Proud, duke of Bavaria (of the line of Welf, a son of the Italian house of Este, to whom Bavaria had been given by Henry IV.), had hoped for the empire for himself. He struggled till his death against Conrad III., and after he died his sons and brother continued the

strife. Their partisans adopted for the war-cry which it was then incumbent upon each side to shout in battle, "A Welf, a Welf!" to which the imperialists replied by adopting the counter-cry "A Waiblingen, a Waiblingen!" this being the natal village of their general, Frederick, the emperor's brother. Discontents were always pope's men, so that the names became perpetuated, Waiblingen for the imperialists, Welf for the papalists and discontents. Italianized into *Guelfs* and *Ghibellines*, they represented the mutual hatred of centuries to come. Conrad III. joined the Second Crusade with 70,000 men, in 1147. Frederick of Waiblingen was his uncle's successor. He was immensely popular, and is best known under the name earned by his red beard, BARBAROSSA. In 1154 Barbarossa went to Italy and was crowned emperor, and unfortunately for Germany he continued to go to Italy for one cause or another. Had he remained in Germany he might have surpassed Charles the Great in power, for his rule was most beneficial and strong, and his subjects loved him with fanaticism. For instance the pope tried to reassert the principles of Gregory VII., and to claim the supremacy of honour over the empire—his messenger would have been torn to pieces had not Barbarossa interfered to protect him! The emperor had been as a youth with his father to the Holy Land, and as an old man also he joined the Third Crusade (1189). But when his followers, in this march, got entangled as they were crossing a narrow bridge in Cilicia, Asia Minor, Barbarossa, in his impetuous way, dashed into the stream to get across, and his horse losing his footing he was carried away and drowned. He was thus not permitted to reach the Holy Land alive, but his body was buried in Antioch (1190). Nevertheless it was firmly held by tradition that Barbarossa had not really died, but had been caught away by spirits, and sat somnolent amidst his knights in a cave of the Kyffhauser Mountains in Thuringia. Peasants from time to time stumbled horrified upon that ghostly company, to be questioned by the hollow voice of the kaiser, "Was it time yet?"—time, namely, to arise and save Germany—and then with difficulty escaping into the upper air they told their tale to willing ears. Barbarossa's son Henry VI. succeeded, and is unfavourably known to us as one of the malefactors concerned in the base detention of Richard of the Lion Heart, king of England, on his way home from the crusade. He was the first to assume the title of King of the Romans during the emperor's lifetime, as his declared successor, a practice always afterwards followed. Henry's son was the brilliant and splendid Frederick II. He was a fine scholar and poet, a man of large heart and broad sympathies, born altogether out of due time amidst the narrow bigotry of the thirteenth century. He was called, and justly so, the Wonder of the World. He was not only king of Germany and Lombardy but of Sicily also, and most of his life was spent in his southern kingdom. His Sicilian laws are a model of jurisprudence. As many Moors were settled in Sicily, Frederick was able to deal with them as few Christian princes could, consequently the crusade which he undertook, though hampered in every possible manner by the actions of the pope (Innocent IV.), was very successful in a practical way, and accomplished its ends without bloodshed. But this very success by peaceful means, this toleration, even the knowledge of Arabic, were all brought against Frederick as criminal charges during his life-long struggle with the popes. It is hardly necessary to say that he was over and over again excommunicated, but it is perhaps not so well known that Innocent sought his life by assassination in the Holy Land, and that his Moslem enemy betrayed to Frederick the plot. This knightly far-glancing figure is last seen fighting for his rule in Lombardy, stirred up by papal agencies to revolt. He died there in 1250. With his son and successor, Conrad IV., his line ceased. In Frederick II.'s time the Teutonic knights began to conquer Prussia bit by bit from the heathen. It was now that Gothic architecture flourished, and that lyric poetry began to take form. The *Nibelungen-lied* likewise took shape in these times.

Period of the Hohenstaufen or Swabian Emperors.—Conrad III., of Hohenstaufen, duke of Franconia, emperor, 1138; Frederick I., Barbarossa, emperor, nephew, 1152; Henry VI., emperor, son; Otto (a Welf prince), emperor, 1197; Frederick II., the Wonder of the World, succeeded upon the deposition of Otto by the pope (Innocent III.) in 1215, son of Henry VI.; Conrad IV., son, 1250—died 1254 without children.

After an interregnum and a time of great confusion Richard of England, earl of Cornwall, the wealthy brother of Henry III. of England, was elected King of the Romans, but he was never crowned emperor, and visited Germany but three times. Rudolf of Hapsburg (in Swabia) was elected in 1273, after Richard's death, and tried to stem the disorders of the land in vain. In the universal welter and discord we see Emperor Rudolf giving the duchy of Austria to princes of his house of Hapsburg, and thus founding the historic line of Austria; and later on we see Henry VII. crowned emperor in 1310, the first since Frederick II. The emperors now begin to retain their own duchies or kingdoms, for the revenue of the empire is insufficient for their support. The Swiss mountaineers round the Lake of Lucerne unite as "Confederates" to make a new German state on a republican pattern, and hold their own against Austrian troops at Morgarten, 1315, Sempach, 1386, Nafels, 1388, &c. Soon they are called *Switzers*, as *Schwyz* was one of the first three cantons of the republic. In 1356 a notable event occurred—the promulgation of the *Golden Bull* by the Emperor Charles IV., settling the mode of election by the seven electors, &c.; the election always to be at Frankfurt and the coronation at Aix-la-Chapelle. This remained the fundamental law of the empire for many centuries. Austria at this time rapidly rose to power under the Hapsburgs, acquiring Carinthia, and later Tyrol, by bequest. The deposition of Wenceslaus in 1400 for neglect of duty; the cowardly behaviour of Sigmund at the Council of Constance in 1415, whereby John Huss, the saintly reformer, though invited under Sigmund's own imperial safe-conduct, was allowed to be burned at the stake, and to be followed by his friend Jerome of Prague (1416); the consequent terrible exterminating wars against the Hussites led by the invincible Ziska, whose skin stretched on a drumhead incited the wild Bohemians to victory even after his death; the sale of the Mark of Brandenburg for 400,000 gulden, in 1415, by the worthless Sigmund to Frederick, count of Hohenzollern, and ancestor of the present kings of Prussia — these are some of the chief events of this troubled time, devoid of order or continuity.

Period of Confusion.—William of Holland, 1254; interregnum, 1256 (Richard of England was elected and crowned 1257, but did not actually reign); Rudolf of Hapsburg, 1273; Adolf of Nassau, 1292; Albert of Austria, son of Rudolf, 1298; Henry VII., duke of Luxemburg, emperor, 1308; Frederick the Fair, son of Albert, and Louis, duke of Bavaria, both elected by rival parties, 1314; agree to rule jointly, 1325; Frederick dies and Louis (emperor) reigns alone, 1330; Charles IV., margrave of Moravia, emperor, 1347; Wenceslaus, son, 1378; deposed 1400; Rupert, elector palatine, 1400; Sigmund, brother of Wenceslaus, emperor, 1410, died 1437.

At length once more a great house was to rise to power in Germany, the Hapsburgs of Austria; and by this family the crown was held without break until, on the accession of Maria Theresa, the male line was extinct (1740). The husband of Maria Theresa, after the one short reign of Charles VII., 1740–45, became emperor; and when at

his death his son, Joseph II., succeeded him in 1765, the empire was once again in the hands of a Hapsburg. It remained so till the very last, the fall of the empire in 1806. With the exception of twenty-five years (and only five years of that is indeed to be fairly reckoned) a Hapsburg was Emperor of Germany from 1438 to 1806—in all 368 years.

The ancient title of King of Germany was now entirely dropped, the sovereigns were Emperors of Germany and Kings of the Romans, and the coronation by the pope was soon abandoned. By the rise to independent power of so many small states and even single cities [see FREE CITIES], who, though all admitting their liability to contribute soldiers to the imperial army (a liability always very reluctantly fulfilled), stoutly refused to pay taxes, the imperial revenue was curtailed almost to the vanishing point, and such lands as formerly constituted the imperial possessions had long since bit by bit disappeared. These causes led the imperial title to become one of supremacy and powerless dignity only, and made it necessary that its holder should be of himself a powerful and wealthy prince, able from his own resources to contribute the practical elements which the now empty title conspicuously lacked. In the articles AUSTRIA-HUNGARY and PRUSSIA, and under the titles of the various principal kings, the details of the history of Germany henceforward are fully given elsewhere in this work. What is necessary here is to trace the general march of events.

On the Emperor Sigmund's death, in 1437, the kingdoms of Bohemia and Hungary, to which he had been elected, passed also by election to his son-in-law Albert of Austria; and this powerful prince, from the reasons above given, was evidently marked out as the German king. He was accordingly elected as Albert II. in 1438, not the first Hapsburg king, for Rudolf and Albert I. had preceded him, but the first of the long uninterrupted Austrian line. Albert II.'s successor, Frederick III. (duke of Styria), was unfortunately unequal to his great position. The empire now eminently required a ruler of energy; for, first, the whole of Europe was ablaze with the schism between the great Council of Basel and Pope Eugenius IV.; and secondly, when by the astuteness of Æneas Sylvius Piccolomini, the emperor's secretary (afterwards Pius II.), this long quarrel was patched up, the news came of the fall of the Eastern Empire and the taking of Constantinople by the Turks (1453). Though really weak, for his authority was everywhere disputed, and he once had to flee for his life (1485), Frederick III. was outwardly imposing as a prince. He reigned longer than any king of Germany (fifty-three years), he was the last to be crowned emperor at Rome, and he received by inheritance all the Austrian states except Tyrol. His son and successor Maximilian (1493) added Tyrol to Austria, and by marrying the heiress of Charles the Bold he also added the Low Countries and what of Burgundy remained after the seizure by France. His dominions were therefore splendid in extent. His son Philip married Juana, daughter of Ferdinand and Isabella of Spain; and their children, Charles and Ferdinand, both eventually emperors of Germany, founded respectively the Spanish and the Austrian branches of the Hapsburgs. Some occurrences under Maximilian are necessary to be mentioned here. The famous Diet of Worms in 1495 abolished the right of private warfare, and set up the Imperial Chamber, nominated by the states for the settlement of disputes, and supported by a tax throughout the empire. Maximilian himself created the Aulic Council as a court of legal appeal, and these two courts lasted till the end of the empire. The Swiss conquered at Dornach in 1499, and Maximilian then formally acknowledged their independence. As he was at variance with the Venetians, and could not enter Italy without a war, Maximilian arranged with Pope Julius II. to take the title of "Emperor Elect," and was never actually crowned. There seems reason to suppose that amid the schemes with which his brain was always teeming, that of himself becoming pope had actually occurred to Maximilian. If he is one of the most interesting figures of the middle ages, his successor, Charles V., is by far the most magnificent. Charles was King of Spain and the two Sicilies, and Duke of Burgundy and the Low Countries, when his grandfather died, for his mother Juana was declared insane (a matter on which rests grave historic doubt), and he ruled in her stead. Francis I. of France, and Henry VIII. of England and other princes, competed with Charles of Spain for the German crown. Charles was elected in 1519, and inheriting all Austria, thus became the most powerful prince in Europe since Charles the Great; indeed his aim was to rival that great namesake of his. He was so feared that to calm apprehensions he began the custom, ever afterwards followed, of solemnly confirming the rights of the several states on election as king. Charles was the last king of Germany crowned emperor, and he was crowned not at Rome but at Bologna. Most unfortunately his dream of dividing the world with the pope, in imitation of his great predecessor, led Charles to take the anti-Reformation side in the great religious struggle which now began under Luther. The celebrated Diet of Worms in 1521 resulted in Luther's condemnation as a heretic; but to Charles' honour the safe-conduct which had led Huss to the scaffold under a former emperor was held in due honour in Luther's case, and he escaped safely to his famous seclusion in the Wartburg. At this same diet Charles gave over to his brother Ferdinand the Austrian states. The long Italian wars with Francis I. of France forced the emperor to avoid raising enemies at home, and thus indirectly helped the Reformation. The Diet of Speyer (Spires) in 1526 declared religious liberty for each state; but at a second diet, held also at Speyer in 1529, it chanced that the majority was Catholic, and the opportunity was taken to forbid further religious changes and to order the universal celebration of the mass. The Lutherans entered formal *protest* against this snap-vote, and their name of *protestants* thus originated. The Swiss reformers under Zwingli were moving on similar lines with Luther, but though Luther and Zwingli met in 1529 they could not agree upon a common profession of faith. The distinction between the *Lutheran* and the *Reformed* church therefore grew up amid somewhat bitter feelings, and exists to this day. Charles sought to settle the religious difficulty altogether at the Diet of Augsburg in 1530, but his interference only produced the splendid Augsburg Confession, still the basis of religious instruction for the Lutheran states; and it ended in the condemnation of the Lutherans as heretics, and the formation of the famous Schmalkaldic League by them in self-defence. Nevertheless, in 1532, the approach of the Turks drove Charles to grant the religious peace of Nuremberg. This was only to gain time; for when the danger was over Charles attacked the Protestants both by actual conflict of arms and in the Council of Trent (1545). Victorious in war at every point, he forced the scheme of the *Interim* to be accepted as a means of religious reunion by the Lutheran princes. Suddenly, as the outcome of secret plots, Henry II. of France and Duke Maurice of Saxony rose against the emperor. Henry seized the bishoprics of Metz, Toul, and Verdun; and Maurice advanced on Charles, who, deserted by every single state, had even to flee for his life. After many concessions the religious peace of Augsburg (1555) at last restored quiet to Germany; but the bishoprics were lost, and no efforts could recover them from France. Charles, disgusted with the failure of his imperial policy, abdicated his Spanish crown in 1555 and his German in 1556, and Ferdinand his brother succeeded him in the latter. Ferdinand I. proclaimed himself emperor at once,

without coronation by the pope; and this was for ever after the custom. He was judicious in religious matters, and his son and successor, Maximilian II., was even broader in his opinions, so as to be openly accused of Lutheranism by the Jesuits, now unhappily beginning their career. The emperors next reigning, Rudolf II. and Matthias, sons of Maximilian, unfortunately leaned toward the Jesuits, and the latter at the close of his reign was compelled to receive his bigoted cousin Ferdinand, duke of Styria, as coadjutor in the empire. Ferdinand II. succeeded, to Germany's lasting misfortune, in 1619. He had already so oppressed the Protestants that at a conference at Prague (1618) with the imperial councillors two of the latter were by the indignant Protestants thrown out of the window of the hall. The Protestants formed "the Union," the Catholics "the League," and both sides armed swiftly. In the meantime Frederick, elector palatine, son-in-law of James I. of England (and whose sons, Princes Rupert and Maurice, were to become familiar to Englishmen later on in the Civil War), was chosen king of Bohemia, at that time Protestant. Ferdinand resolved to begin his new "crusade" against Protestantism with Bohemia, and accordingly sent Count Tilly, the most cruel soldier of that cruel time, against the devoted land. The "winter king" was hopelessly defeated and fled, his electoral dignity was given to Bavaria, and Bohemia was treated with appalling severity. The Protestants were exterminated, either slain or banished to a man; the famous universities fell, the flourishing trade ceased, and the land was ruined for centuries; but it became for ever Catholic, and Ferdinand was well pleased. Thus began the THIRTY YEARS' WAR, with Tilly and later on Wallenstein on the Catholic side, and Mansfeld and later on Gustavus Adolphus of Sweden on the Protestant side. At its close (peace of Westphalia, 1648) nearly two-thirds of the people of Germany had perished, the whole country was a wreck and a waste, trade existed nowhere, and even the Hanseatic League was broken up because the several cities were unable to support its expenses. Only the general misery stopped the war, for neither side liked the terms of peace, and the pope openly protested, and repudiated the transaction. France, who had taken part in the war, added further to her spoliations westward of the Rhine. An eighth electorate was made to restore the palatinate to its former dignity. The Elector of Brandenburg acquired by this treaty Pomerania, Magdeburg, Halberstadt, Minden, and Kamin. It should be mentioned that Albert of Brandenburg, finding himself head of the Teutonic order of knights who had conquered Prussia (Preussen) from the heathen eastward of the Baltic, had in 1525 abused his position so far as to destroy the order altogether and make himself hereditary Duke of Prussia. Albert was not elector, but in 1661 the duchy of Prussia passed from his descendants to their relatives the electors of Brandenburg. It was a most important accession for Brandenburg, since the duchy of Prussia was not a German fief at all. By this peace of Westphalia all the states indeed acquired sovereign rights, except on matters affecting the empire. Therefore, for practical purposes, the power of the emperor over the German states may be considered as now ceasing.

On the death of Ferdinand III. (1657), son and successor of Ferdinand II., it is worth noting that Louis XIV. of France, "le Grand Monarque," tried hard to gain the imperial crown by bribery and negotiation. Ferdinand's son, Leopold I., however, succeeded him. Louis on the first pretext invaded Germany, and annexed to France nearly all that was left of Lothringen and all Elsass, including the fine city of Strasburg, which in 1681 he seized while the people were at Frankfurt fair, though it was three years since peace had been proclaimed at Nimeguen (1678). Only in 1871 did Germany regain these provinces from France. In the second war of Louis with Germany the disasters suffered in the first by the states of Holland were amply avenged, for William of Orange was now king of England, and it was he who led the allies. The peace of Ryswick terminated hostilities in 1697. Frederick-William, elector of Brandenburg (called the Great Elector), had raised the electorate to a commanding position in the first French war; and his son, though unequal in sagacity to the Great Elector, so worthily continued his efforts in the second French war that he felt strong enough to proclaim himself King of Prussia in 1701, and to gain the emperor's consent. King of Brandenburg he could not be, though here his main power lay; but, as was observed before, Prussia, the half-barbarian state in the east of the Baltic, lay beyond the empire, and was a convenient possession for the new king's ambitious purpose. At the same time Hanover was made an electorate (the ninth), and a few years later (1714) its elector George succeeded to the kingdom of England. But before this last event occurred, and while Anne was yet Queen of England, the war of the Spanish succession broke out through the greed of Louis XIV., which gave room for the splendid abilities of Marlborough and Prince Eugène of Savoy to display themselves. Marlborough deserved his title of a prince of the empire by his wonderful victories of Blenheim, Oudenarde, and Malplaquet (1702, 1708, 1709), and doubtless Louis' grandson would never have replaced a Hapsburg by a Bourbon on the throne of Spain, had not the great captain been recalled by cabals at home. By the disgraceful peace of Utrecht, which followed in 1713, the Emperor Charles VI. (son of Leopold) was deserted, and saw himself forced to agree to the peace of Rastatt in 1714. Philip V. (Bourbon), grandson of Louis XIV., was recognized as King of Spain, but Austria received in exchange the Spanish Netherlands, Naples and Sicily (afterwards exchanged for Tuscany and Parma), Milan and Sardinia. But the Emperor Charles VI. had no son, and the last years of his life were spent in gaining the adhesion of the great princes and powers to the Pragmatic Sanction, which he promulgated in 1713, providing that the Austrian dominions should pass to females on the extinction of the male line. This was to secure the succession of his daughter Maria Theresa. The troubles which this arrangement led the emperor into were endless. One of them was the cession of the still German fragments of Lothringen (Lorraine) to the deposed King of Poland, father-in-law of Louis XV., whereby in a few years it came into the possession of France.

Maria Theresa ascended in 1740, but soon found that her only sure possession was the kingdom of Hungary (which had been declared hereditary, and no longer elective, in 1687). The opportunity for acquiring Silesia under an old claim was too tempting for the young King of Prussia, Frederick II., to refuse it. The first and second Silesian wars between Frederick and the queen followed—the latter war nominally begun in favour of the Emperor Charles VII. (elector of Bavaria), a feeble and quite powerless prince, who was mostly in exile during his brief reign. On Charles' death in 1745, Francis, grand-duke of Tuscany, husband of the Queen of Hungary, was elected emperor, the true sovereign being Maria Theresa herself. The rivalry of Prussia and Austria had now begun, not to close until, in 1871, the latter was pronounced a non-German power. Eight years' breathing time was allowed (1748-56) between the Silesian wars and the terrible Seven Years' War, wherein Frederick, now called the Great, held all Europe (save only England) at bay. [See FREDERICK II. OF PRUSSIA.] A change of sovereigns in Russia brought that country at last on Frederick's side, and as all Europe was exhausted, not to say ruined, the peace of Hubertsburg stayed the awful scourge of war in 1763. The perilous price, however, had been paid, and Prussia was felt to be now one of the leading powers of

Europe. In 1772, at the first partition of Poland, she received her share as well as Austria and Russia, and Prussia proper was by this means joined to Brandenburg.

The accession of Joseph II. to the empire on the death of his father, 1765, and to Austria on the death of his mother, 1780, restored the nominal power to the Hapsburgs. The good emperor was full of benevolent schemes, loved peaceful pleasures (witness his steady patronage of Haydn and Mozart), and was even disposed to be despotic in improving his country. He closed over 600 monasteries in an attempt to reform the church. But he was far in advance of his age, and the broad ideas which we so much admire were at that time only productive of discontent and mischief. The worry of what seemed to him ingratitude was probably the cause of Joseph's death in 1790. His brother Leopold II., quiet and perhaps a little reactionary, succeeded as emperor far better than the excellent Joseph.

Francis II., the last emperor of Germany, succeeded his father Leopold in 1792. He had at once to face the crisis of the French Revolution, and in two years saw the head of his aunt (Marie Antoinette) fall like that of a common criminal on the scaffold. The Netherlands revolted and threw themselves into the arms of France; the imperial forces were ruinously costly while effecting little in the war against the French Republic, and Prussia and Russia, after uniting to make a second partition out of the Polish states in 1795, made a separate peace with France. Austria with all these griefs sought compensation in a large share of the final and third partition of all that remained of Poland. But disasters were to come. Bonaparte had now appeared, and in 1796 he thoroughly defeated the Austrian Italian forces at Lodi, pushing on into Austria itself in the next year. The emperor was forced to agree to the peace of Campo Formio, giving up (secretly) the left bank of the Rhine to France, and (openly) receiving Venice, Istria, and Dalmatia in return. At the Congress of Rastatt in the same year the French conqueror insolently dictated conditions to the cowed and trembling Germans. While Bonaparte was in Egypt an opportunity seemed to offer itself, and Austria joined Russia and England in the French war of 1799. Bonaparte, however, returned, and his presence was soon felt in the conquest of Italy at Marengo (1800), while Moreau crushed the forces in Germany at Hohenlinden in the same year. The emperor hurriedly signed peace at Lunéville at the beginning of 1801. The new French nominee to the grand-duchy of Tuscany was made a tenth elector in virtue of the territory of the archbishopric of Salzburg, which he received at the hands of Bonaparte, and the matter of the Rhine frontier was now openly agreed to by the entire diet at Regensburg, 1802, the dispossessed princes being compensated in various ways. The Landgrave of Hessen-Cassel, the Duke of Würtemberg, and the Margrave of Baden became the eleventh, twelfth, and thirteenth electors. The freedom of forty-eight of the free cities was suppressed. Germany groaned beneath the heel of the conqueror, who now proclaimed himself an emperor (of France), and indeed possessed more of the realities of empire than any emperor since Charles V. Bonaparte did not, however, suppress the ancient Empire of Germany: he left it to fall of itself. The seizure of Hanover in 1803, and many other insults, failed to rouse Germany: but Austria by herself again joined England, and Russia and Sweden came into the league also, and declared war in 1805. Many German states even joined Bonaparte against their own brethren, so low had German brotherhood fallen. The capitulation of Ulm, the taking of Vienna, and the battle of Austerlitz, all occurring in 1805, hurried the emperor to peace, in spite of the triumph of England at Trafalgar, and the treaty of Presburg was signed in December of the same year in which the war had begun. Austria was crushed, her conqueror was pitiless, and she lost Venice, Tyrol, Swabia, &c. Bonaparte raised the Electors of Bavaria and Würtemberg to the rank of kings, and Baden became a grand-duchy, all these being declared sovereign states, independent of the empire. Worse was to come. In June 1806, at the invitation of Bonaparte, the Kings of Bavaria and Würtemberg, the Electors of Baden and Hessen-Cassel, and some other princes constituted themselves the Confederation of the Rhine, acknowledging the French emperor as their head, and recognizing their war-contingent due to him as 63,000 men. The Archbishop of Mainz, now transferred to Regensburg, who had once been convener of the ancient imperial electoral college, was now pronounced primate and French representative in the new confederation. Two emperors could not exist together in Germany, Francis therefore quietly altered his title to that of Emperor of Austria (1806), and the Empire of Germany had come to an end.

Hapsburg Emperors of Germany (or emperors of the house of Austria).—Albert II. (duke of Austria), 1438; interregnum, 1439; Frederick III. (duke of Styria), emperor, cousin, 1440; Maximilian I., emperor elect, son, 1493; Charles V., emperor, nephew, 1519; Ferdinand, brother, 1556 (Ferdinand and all succeeding princes took the title of emperor without coronation by the pope); Maximilian II., son, 1564; Rudolph II., son, 1576; Matthias, brother, 1612; Ferdinand II., cousin, 1619; Ferdinand III., son, 1637; Leopold I., son, 1657; Joseph I., son, 1705; Charles VI., brother, 1711; Charles VII. (elector of Bavaria), 1740; Maria Theresa, archduchess of Austria and queen of Hungary, daughter of Charles VI.; Francis I. (grand-duke of Tuscany), husband of Maria Theresa, elected 1745; Joseph II., son of Francis I. and Maria Theresa, 1765; Leopold II., brother, 1790; Francis II., son, 1792, resigns empire of Germany, 8th August, 1806. (The empire ceases. Francis becomes Francis I., emperor of Austria.)

The turn of Prussia, which had selfishly held aloof, was now to come. Bonaparte, by many and various insults, left it no option, and war was declared in 1806, only to result in the disastrous defeat of Prussia at Jena and the occupation of Berlin. At the peace of Tilsit, in 1807, Prussia lost her Rhine provinces, and these were made into a new kingdom, that of Westphalia, for Jerome Bonaparte, with Brunswick, Hessen-Cassel, and part of Hanover added. Saxony was also enriched and made a kingdom in reward for the elector's services to Bonaparte. Altogether Prussia lost 5,000,000 subjects and more than half her territory, besides paying an indemnity of £6,000,000.

Yet once again, however, Austria determined to try fortunes with the French emperor, and war was declared in 1809. In about six months the battle of Wagram, outside Vienna, again forced the Emperor of Austria to sue for peace, and again to submit to severe losses of territory. Tyrol, decreed by the conqueror to his ally Bavaria, refused, however, to acquiesce, and under the brave Hofer for many months maintained its independence. Saxony was also further rewarded at the expense of Austria. Since 1807 Prussia, bound down to an army of only 42,000 men, had been silently passing the whole nation quickly through the limited squadrons. In 1813 the king (Frederick-William III.) felt strong enough to call upon Germany for a last effort, the tyrant being now heavily burdened in consequence of his disastrous retreat from Moscow. His proclamation was issued from Breslau, for Berlin was under the power of the French, who since 1810 had annexed the whole northern coast of Germany as far as the Elbe. The brutality of Bonaparte now bore bitter fruit. Even the professors from the colleges, as Fichte and Froebel, ran to arms. Russia, and later on Austria and Sweden, joined Prussia. At first the allies were defeated, but gradually fortune turned. Blücher won many laurels, and eventually

at Leipzig (16th to 19th October, 1813) Bonaparte was completely crushed. He certainly lost 70,000 men in this sanguinary battle. The Emperor of Russia and the King of Prussia entered Paris in triumph, 31st March, 1813; and shortly after Bonaparte was banished to Elba. Now came the task of restoring order to Germany. The great congress of Vienna met in 1814. All the territory taken by France since 1792 was given back to Germany; the Confederation of the Rhine and the kingdom of Westphalia were broken up and the territories restored to their former owners; but Prussia demanded Saxony, and Russia the whole of Poland, as the reward of sacrifices in the late wars. Disputes ran high till the news came of Bonaparte's escape from Elba. Then all contest was forgotten in the necessity of the hour. The brilliant campaign of Waterloo in 1815, in which England bore the lion's share, once more, and this time for ever, put an end to the tyrant's schemes; and the sacrifices necessary had brought all parties to their senses. The congress of Vienna quickly came to a close. Austria recovered Tyrol, Salzburg, Voralberg, and the Innviertiel, and Lombardo-Venetia as well. Prussia regained her position as before Tilsit, and much of north Saxony and the Rhine country were added to her. Bavaria was also enlarged, and Hanover too, the latter being made a kingdom.

It was felt to be hopeless to restore the empire, as the jealousy of Prussia and Austria was all too manifest. A confederation (Bund) was substituted, consisting of thirty-nine states, each independent except for common national purposes; the Diet of the Bund to sit in Frankfurt, and to be presided over by Austria. The articles of confederation demanded that constitutional government should be granted in all the states of the Bund, but as this was not carried out many riots occurred in various states about 1830, in one of which the palace of the Duke of Brunswick was burnt to the ground. The Bund was manifestly a failure, and only a custom's union (Zollverein) at this time served as a slender link of union amid the distracted and jarring elements of the German peoples. In 1835 Francis I. of Austria died, and was succeeded by Ferdinand. In 1837 Hanover became free from the English royal power on the accession of Queen Victoria, as Hanover was subject to the Salic law so called, that is, to the exclusion of female sovereigns. The new king (Ernst) was violently reactionary, and Hanover was the scene of much discontent. Many distinguished professors who were Liberals, among them the learned brothers Grimm, were roughly dismissed from Göttingen University. In 1840 Frederick-William III. was succeeded on the throne of Prussia by his son Frederick-William IV., who at once began the important national work of completing the Cathedral of Cologne, and in many ways encouraged science and art. (Among other things he induced Mendelssohn to incur the drudgery of founding the Berlin Conservatoire of Music, and specially requested the composition of some of his most famous works.) These things were not without effect upon the Germans, eager after unity. If the king had been less possessed with the "divine right" notion so long inherent in his family, he might have easily led Germany to a new future. But he resisted all reform; and consequently, when the general European rising occurred in 1848, not only Vienna but also Berlin were the scenes of considerable disturbance. At the same time a number of representative men (about 500) met in Frankfurt and constituted themselves a National Assembly amidst the universal approval of Germany. A central government was formed and agreed to, the Archduke John of Austria was chosen president, and the whole scheme was provisionally accepted by the various states as replacing the effete Bund. But unhappily Denmark put forward a wrongful claim to Holstein as a Danish duchy (whereas it was strictly a German duchy, the duke of which happened to be the King of Denmark), and this upset the unanimity of the National Assembly. War was declared, but was inefficiently prosecuted; and eventually, at the bidding of Prussia, an armistice was agreed to. In December, 1848, the Emperor Ferdinand abdicated in favour of his nephew, Francis Joseph. On this an attempt was made to shut out Austria from Germany altogether, and to admit the superior force of Prussia, offering the king the hereditary title of Emperor of the Germans. This, however, the king declined in April, 1849, as he considered the proposed constitution did not give sufficient authority to the emperor. This was the deathblow of the Assembly, which shrank by repeated defections, until Würtemberg put an end to it by turning it out contemptuously from Stuttgart (18th June, 1849). Again the stiffness of the King of Prussia had destroyed the hopes of unity for Germany. The king, however, tried to content the aspirations of Germany in his own way. He summoned a parliament at Erfurt to consider his proposals. Austria, who, during 1848–49, had had a life-and-death struggle with the republicans under Kossuth and Gorgei in Hungary, and had only just succeeded in retaining that kingdom, now roused herself, met Prussia in a tolerably friendly manner, and as a temporary measure restored the old Bund, which, therefore, after a suspension of three years, was now (June, 1851) galvanized into a semblance of renewed life.

In 1861 Frederick-William IV. was succeeded by his brother Frederick-William-Louis, who, as William I., has become famous to our generation. Backed by the strongest statesman of modern times, Otto von Bismarck, he set himself resolutely to the work of preparing for the coming struggle, in direct violation of the liberty of his people and of the constitution. His great success may blind many to the characteristic way in which it was attained. Like a true Hohenzollern he has refused to work except after his own despotic fashion. The Schleswig-Holstein question soon gave him his opportunity. Some time previously Denmark's wrongful holding of the duchies had been agreed to by the powers, but not by the duchies themselves, nor by the Diet of Germany. The King of Denmark now proceeding to further alter the constitution of the duchies, the Bund stepped in and ordered Prussia and Austria jointly to occupy them while the question of inheritance was decided. The Duke of Augustenberg seemed to have the prior claim, as the male line of Denmark had died out with Frederick VII. But the duke's father had complicated matters by resigning his claim (under protest from the son) in 1852. The question was, however, never decided. Prussia was determined to possess the spoil, and encouragement of the Augustenberg claim by the Austrians was laid hold of as a pretext for remonstrance by Prussia. As Bismarck had said, the regeneration of Germany was only possible "through blood and iron," and he was now ready. Accordingly in 1866 General von Moltke drew up a plan of campaign, and war began in June. The duchies in dispute, and also Hessen-Cassel, were at once annexed, Saxony conquered and partly annexed, and Hanover conquered and wholly annexed, the entire army capitulating and the king (Duke of Cumberland in the peerage of Great Britain) retiring to his English relatives. A short, sharp conflict in Bohemia ended in the defeat of the Austrians at Sadowa and the annexation of Frankfort and Nassau by Prussia. By the treaty of Prague Austria consented to her perpetual exclusion from Germany, to the cession of the Holstein duchies, and to the payment of 40,000,000 thalers (say £6,000,000) as the Prussian expenses of the war. In an Italian war in 1859 Austria had lost Milan, and now, as the price of Italy's co-operation with Prussia, she forfeited Venice also. Germany has never since held aught of Italy. Prussia was now the most powerful state in Europe, and the

national pride of France could not suffer such a reversal of Napoleonic glory. Accordingly the French Emperor, Napoleon III., who had more than once demanded in vain indemnities for his neutrality in the Austro-Prussian War, only to be met with clever manœuvres on the part of Bismarck, now seized a ridiculous pretext (the candidature of a Hohenzollern prince for the vacant throne of Spain, disavowed almost as soon as put forward) to force the King of Prussia into war in 1870. The events of the war are narrated in the article FRANCE. Suffice it to say here that it proved utterly disastrous to Napoleon III. and his country, and ended in the capitulations of Sedan and Metz, with the emperor and nearly 270,000 troops, the entire soldiery of France. A brave but altogether desperate attempt was made by the French republic, which now took the helm of government, to continue the unequal conflict, but in March, 1871, the Germans entered Paris, and the famous indemnity of £200,000,000 was agreed to, as well as the restoration of all Elsass (except Belfort) and Lothringen. The French part of the latter (French Lorraine) was not taken from France. This war directly brought about the unification of Germany.

In 1867 the South German states had split off, Baden rather unwillingly, though by a secret treaty engaging to give the King of Prussia command of their troops in time of national war. The other states had formed themselves into a North German Confederation, with an elected diet and a representative federal council, under the presidency of Prussia. These bodies had warmly supported Prussia in the war of 1870, and the South German states had proved unexpectedly true to their engagements. (It was this last stone which brought down the French emperor's policy.) Fighting shoulder to shoulder South and North Germans forgot their differences, and in October a union of the whole country was planned. In December the King of Bavaria proposed that the new German Confederation should become a German Empire, with the King of Prussia as hereditary emperor; and on the assent of all concerned King William was proclaimed Emperor of Germany in the Hall of Mirrors at Versailles on 18th January, 1871, with all the pomp of ceremony befitting so august an occasion. But what was far more impressive to those who looked beneath the surface was the fact that this great step in German history should happen to be taken when the Germans were at last victorious over that country which had so long oppressed them (and what was far worse, fomented their intestinal divisions), when the new emperor's headquarters were in the palace of Louis XIV., and Paris lay helpless and starving at his feet.

Thus has once more the unity of Germany been attained. That it may be permanent, and that so great a nation may for almost the first time in its long history have fair opportunities of developing its vast resources, cannot but be the prayer of every one belonging to our own kindred folk of England; for it must never be forgotten that by race and speech Englishmen and Germans are brethren. A strong Germany, central in force as well as in position in the European commonwealth, is not only a source of pride to fellow-Teutons, it is further the main and very chief guarantee for that peace of Europe for which all good men thirst these many weary years.

GERMANY, LANGUAGE AND LITERATURE OF. See GERMAN LANGUAGE AND LITERATURE.

GER'MEN, a name applied by the Linnean school of botanists to what is now called the ovary of a flower.

GERMINA'TION, the first growth of a seed, the act by which it exchanges the condition of an embryo for that of a young plant. The embryo of a plant is folded up in the inside of a seed, and is either a short double cone on which two or more cotyledons are fixed, or a simple more or less cylindrical body, having no apparent distinction between the cotyledons and the axis. [See EMBRYO.] It has, moreover, little other than a cellular organization, very often not possessing a trace of the complicated vascular and tubular structure afterwards developed. The act of unfolding, breaking through the integuments of the seed, and acquiring a vascular and tubular as well as cellular organization, is germination. Three conditions are necessary, namely, heat, moisture, and communication with oxygen. When these conditions are favourable there is a formation of sugar (turned to account in the process of malting); the embryo is thus supplied with food until its stem has lengthened and carried up the first leaves to the sun and air.

Attempts have been made to expedite the process of germination, by steeping seeds in a weak solution of chlorine, but no practical advantage has been derived from the experiment. A more effectual plan has been found for hard-shelled seeds, such as those of the Acacia, namely, boiling the seeds for a period between one and five minutes. This has certainly, in some cases, had the effect of causing seeds to grow which under ordinary circumstances would not have grown; a circumstance to be ascribed, we conceive, to the hard integuments of the seed being so much softened as to offer no great resistance to the attempts of the embryo to escape from within them—attempts which required no assistance when the embryo was in full activity and the seed coat comparatively soft, but indispensable when these conditions are reversed by the loss of vigour in the embryo and the excessive induration of the case containing it.

GERMS OF DISEASE, a phrase which has long been in use both in popular language and in medical writings, and has received fresh significance during recent years from the labours of several eminent microscopists, who have investigated the origin and morbid processes of many forms of infectious disease. It has long been known that there are many diseases which, whatever may have been their original cause, are in nearly every case the result of some poison introduced into the system from some other person suffering in a similar manner. Very often the mode of communication can be clearly traced, and the various stages of the disease accurately determined; and though in many cases this is impossible, the modes by which infection can be conveyed are known to be so subtle and so numerous that a conveyance of the disease is always surmised in spite of defective information. Another fact that has long been known is that when the poison of disease is conveyed by infection it always involves a large multiplication of material possessing the same infective property. The amount absorbed by the subject in the first instance may have been exceedingly minute, but when its effects have become manifest in the production of disease, the diseased body, either in part or as a whole, yields a large supply of the special agent of infection. This process in the living organism bears a striking resemblance to that of fermentation which occurs in non-living bodies, a circumstance which was first pointed out by Liebig. As already explained under FERMENTATION, yeast, which is a rudimentary plant composed of cells, when added to a suitable medium, such as a solution of sugar, rapidly multiplies, the yeast cells feeding upon the sugar, and giving off alcohol and carbonic acid until the whole character of the liquid is changed. In a somewhat similar way certain poisons when introduced into the blood cause diseases which gradually affect the whole mass, and as the yeast has no power over fully fermented liquids, so there are forms of disease which, after being once endured, appear to give immunity from any future attack. The nature of the germ, however, by which infection is conveyed was for many years the subject of considerable controversy, and it is only within a very recent period that the secret has been discovered. The experiments of Pasteur in investigating the cause of the silkworm disease, which for many years

had made great ravages in France, proved that animal germs might be the cause of disease of a very infectious and destructive kind, and subsequent experiments led him to the conclusion that such germs had a real independent existence as organized solids either of a vegetable or animal character. Subsequent researches by Pasteur, Smart, Lister, Obermeir, Klein, Burdon-Sanderson, Koch, Manson, Eberth, and others have thrown considerable light upon the nature of these germs, and it may now be considered as fully proved that numerous diseases are caused by the reception into the body of certain living organisms, and their subsequent development and multiplication in the system. The study has been attended with considerable difficulty, inasmuch as the objects which have to be scrutinized are so exceedingly minute, and often so much alike, that even the highest powers of the microscope, when employed by patient and experienced observers, will fail to detect them. Notwithstanding these difficulties, the germ which gave rise to the cattle plague, commonly known as the rinderpest, was discovered and delineated in 1865, and since then the distinctive micro-organisms of splenic fever, malignant pustule, typhoid fever, and consumption have been detected. A description of these microphytes has already been given in this work [see BACTERIA], and quite recently two fresh discoveries have been announced in the detection of the cholera germ by Dr. Koch, and that of hydrophobia by Pasteur. It must, however, be observed in connection with this part of the subject, that some of these discoveries are too recent for a full and complete investigation to have been accorded them, and even in those cases where a specific microphyte has been found competent observers are not agreed as to its presence being the cause of the disease.

One theory of considerable importance has already been based upon these discoveries—viz. that by attenuating the strength of the living organisms, and using the attenuated virus for inoculation, immunity from their attack may be secured. [See BACTERIA and HYDROPHOBIA.] Another point brought into prominence by the germ theory is the preventible character of many of the diseases which cause such enormous suffering and loss of life in every civilized country. This part of the subject is elsewhere referred to [see CONTAGION], and is noticed in connection with the articles relating to the different forms of special infectious disorders, but its importance will justify a few additional observations here. The chief zymotic diseases with which we have to deal are scarlet fever, typhoid fever, typhus fever, small-pox, measles, diphtheria, and Asiatic cholera. Whenever either of these diseases enters a household the patient should be, if it is in any way possible, separated from the rest of the inmates, and if there are any children they should be kept from school and from playing with others. Seeing also that anything that will retain dust will also retain the germs of disease, all unnecessary furniture and such articles as carpets, cushions, curtains, &c., should be removed from the sick chamber. Effective ventilation should be secured, a fire constantly burning being a good means of securing this, and the strictest cleanliness should be observed. Further, it is most important that all clothing and bedding removed from the patient should be at once disinfected. It has been proved that many disease germs are destroyed by extremes of temperature, hence clothes may be rendered safe by baking and linen by boiling, and where this cannot be done a good substitute is found in the putting of all soiled linen, &c. into carbolic acid and water, one wine-glassful of the acid to each gallon of water, for twelve hours before it is washed. All discharges from the sick person, whether from the throat, mouth, nostrils, or bowels, should be received into vessels containing disinfectants, or if they are received upon cloths, such should if possible be burned, and if this cannot be done, they should be very carefully disinfected. Small-pox germs pass off into the air chiefly from the skin and mucous membranes, and the contagion operates for a considerable distance from the patient. The germs of typhus fever are exhaled from the skin and lungs, saturating bedding and clothes, and clinging to the walls of the room with great persistence. Scarlet fever germs seem to be given off from all parts of the body during an attack, but the greatest danger arises from the peeling of the skin, the small particles of which are highly infectious. Diphtheria and hooping cough chiefly infect by the discharges from the throat and air passages; while the germs of typhoid fever and Asiatic cholera are chiefly conveyed by the discharges from the intestines. Concerning the latter disease Dr. Koch believes that the microbe, which he considers to be its cause. is not inhaled with the breath, but is usually swallowed in water or with fruits or vegetables. It can be destroyed by heat, and he recommends that when the disease prevails all food should be well cooked and all drinking water should be boiled before using.

The germ theory has already suggested very valuable improvements in the practice of surgery, and it may be reasonably hoped that as it becomes more fully investigated it will place new methods of combating disease into the hands of the medical profession; and possibly when the necessity for the isolation of those assailed by infectious disease has been recognized by the public mind, it may lead to the complete extinction of some of those affections which are at present so intractable and persistent.

GERS, a department in the south of France, formed out of the territory of Armagnac and a small portion of Comminges, is bounded N. by the department of Lot-et-Garonne; N.E. by that of Tarn-et-Garonne; E.S.E. by that of Haute Garonne; S. by that of Hautes Pyrénées; W. by Basses Pyrénées and Landes. It extends from 43° 17′ to 44° 4′ N. lat., and from 1° 11′ E. to 0° 16′ W. lon. It greatest length E. to W. is 73 miles; N. to S., 53 miles. The area is 2425 square miles, and the population 281,532.

The lower slopes of the Pyrenees, running generally from north to south, cover the greater part of the surface. The most important of these ridges runs north by west, and separates the basin of the Garonne from that of the Adour. Thirty-eight water-courses mark out as many valleys of greaty beauty and fertility, opening in width from a few yards in their southern to 3 or 4 miles in their northern extremities, and separated from each other by ridges of hills. The rivers Save, Gimone, Arratz, Gers, Baise, and Losse flow northwards through the department on their way to join the Garonne. The Midou and the Douze flow north-westward, and unite at Mont-de-Marsan in the department of Landes to form the Midouze, a feeder of the Adour. The Arros joins the Adour in this department a little below Plaisance. The Adour itself crosses the south-western angle of the department, receiving several mountain streams on its left bank. All these rivers are subject to inundations at the time of the melting of the snows on the Pyrenees, and none of them are navigable. The gradual rise of the country from north to south is seen by the height of the hills inclosing the valley of the Gers. On the confines of Lot-et-Garonne these hills are 318 feet, at Auch 721 feet, and at Mont d'Astarac 1180 feet above sea-level.

The climate is very changeable. From October to May rain, snow, and frost alternate, the cold being most intense in January; from May to the end of June the weather is warmer, and thunder and hail storms are frequent; July and August are very hot; September is the most agreeable month, but even then the mornings and evenings are cold. The prevailing winds blow from east and west.

The surface consists of a stiff clay, resting on thick layers of clay of great depth, separated in some instances by thin layers of sand or tufa. The nucleus of the hills is argillaceous limestone. Breadstuffs are grown in quantity, more than enough for home consumption; wheat, maize, pease and beans, oats and rye, cabbages of various kinds,

garlic and onions, are cultivated extensively. Horned cattle, sheep of inferior breed, mules for the Spanish market, swine, game, and poultry are abundant. Geese and ducks especially are very numerous, and of large size; their wings and legs are salted for export. Marble, building stone, plaster of Paris, marl, potters' clay, and a fusible spar used in glass and china works, are found. There are some mineral springs, but no metals, in the department.

Of manufacturing industry there is little. Coarse woollens, brick, glass, pottery, and other articles of common necessity are made for home use. The quantity of leather tanned is in excess of the consumption, and some of it is exported. The other exports are brandy, wine, corn, flour, wool, poultry, and cattle.

The quantity of wine produced in this department yearly is about 25,000,000 gallons, about one-fourth of which is used for home consumption, and the greater part of the remainder is distilled into brandy, known by the name of Armagnac, from the former name of the district. In quantity of alcohol the Armagnac brandies bear to the Cognac the ratio of 19·5 to 22. As respects mildness and delicacy of flavour, and a peculiarly agreeable aroma, both of which qualities improve with age, the Armagnac is very superior; and it has this advantage over Cognac, that it comes from the still at a strength ready for consumption, whereas Cognac requires reduction of strength, which process, it need not be said, endangers, and may mar, the peculiar excellencies of that spirit. The best qualities of Armagnac are distilled from two varieties of white grape called *piquepoul* and *clairet*, in the cantons of Montréal, Eauze, Cazaubon, Manciet, and Nogaro.

The department is divided into five arrondissements —Auch, Lectoure, Mirande, Condom, and Lombez. The capital of the department is AUCH.

GERSON, JEAN DE, an eminent French scholar and divine, whose real name was Jean Charlier, his name Gerson being derived from the place of his birth. He was born in 1363, and was known as "the most Christian doctor." From 1395 to his death in 1429 he was chancellor of the University of Paris. His later years were spent chiefly in writing books of devotion and of consolation, which brought to him the title of Doctor Consolatorius. The famous work of Thomas à Kempis, "The Imitation of Christ," was at one time, but improperly, attributed to Gerson.

GER'VASE OF CANTERBURY, an historian of the latter part of the thirteenth century, was a monk of Christ Church in that city. His "Chronicle of the Kings of England," from 1122 to 1200, and a "History of the Archbishops of Canterbury," from St. Augustine to Archbishop Reginald Fitz-Joceline, who died in 1191, are his principal works.

GER'VASE OF TILBURY, an historian of the thirteenth century, received his name from Tilbury in Essex, where he was born. Through the interest of the Emperor Otho IV. he was made marshal of the kingdom of Arles in France. He appears to have written a commentary upon Geoffrey of Monmouth's "History of Britain;" a "History of the Holy Land;" a treatise, entitled "Origines Burgundionum;" and a "History of the Kings of England and France," comprised in a work entitled "Otia Imperialia," a fragment of which is printed with his name in Duchesne's "Historiæ Francorum Scriptores," tom. iii. p. 363.

GESE'NIUS, FRIEDRICH HEINRICH WILHELM, was born at Nordhausen on the 3rd of February, 1786. He was educated in the gymnasium of his native place, and afterwards in the universities of Helmstedt and Göttingen. In 1809 Gesenius was appointed professor of ancient literature in the gymnasium of Heiligenstadt. In the year following he accepted the appointment of professor-extraordinary of theology in the University of Halle, where, in 1811, he was raised to the post of ordinary professor. During the summer of 1820 he made a journey to Paris and Oxford, where he collected materials for his lexicographical works on the Semitic languages. He died on the 23rd of October, 1842. Gesenius was one of the greatest scholars of modern times in his particular department of Oriental literature, and the light he has thrown on the Semitic languages, and especially on the Hebrew, has made a new era in this branch of philology. As a theologian he belonged at first to the Rationalistic party, but after the appearance of Strauss' "Life of Christ" he joined the philosophical and critical school, in consequence of which he was often very severely attacked by the orthodox party. His works on the Hebrew tongue enjoy a universal reputation, and some of them are translated into most European languages. Among the most useful, or those most used, are his "Hebrew and Chaldee Lexicon to the Books of the Old Testament," his works on Hebrew Grammar, and his German translation of Isaiah, with a commentary.

GESITHS' were the predecessors of the THEGNS in England. They were the personal following in war of the early English kings, and their court or household in times of peace. Gesiths came into power both in England and in Germany about the same time, as a natural concomitant of the growth of the royal prerogatives. At first distinctly inferior to the old Teutonic nobility of the eorls, or eorlworthy families (a nobility of race), this newer nobility of service gradually absorbed its rival. The kings soon began to reward their gesiths (or in the Latin chroniclers, the *comites*) with grants of the national land, the FOLC LAND. The gesiths become thegns or mere body-servants of the king in the days of Athelstan, at the same time being so lavishly rewarded, and their wergild (or death-fine) being so greatly raised, as to make it evident that the king's service was the patent of nobility and consideration.

GESNERA'CEÆ, an order of GAMOPETALÆ allied to SCROPHULARINEÆ, and with them forming a portion of the Personales group. They inhabit the hot and damp parts of South America, and in some cases overrun trees with their rooting stems, in the manner of ivy. The prevailing colour of their flowers is scarlet; some, however, are purple, as the Gloxinias, and others pale green, as Sinningia and Drymonia. Many beautiful kinds are cultivated in our gardens. They are of no known use. In this order the ovary is half inferior or superior, one-celled, with parietal placentas, or sometimes imperfectly two-celled by the intrusion of the placentas. The seeds are numerous, the albumen generally small and sometimes wanting. The Cyrtandreæ, at one time made into a separate order, is included by Bentham and Hooker ("Genera Plantarum," 1883) in this order—the free ovary and the exalbuminous seeds being the chief points of difference.

GESS'LER, ALBERT, Count von Bruneck, the famous governor of the Swiss Cantons, was certainly an historical personage, whatever Tell may eventually prove to be. Gessler was appointed in 1300, with the Count von Landenberg as assistant, to the governorship of certain free states round the Lake of Lucerne. These states had always acknowledged the supremacy of the King of Germany, emperor of the Romans. When the counts of Hapsburg became dukes of Austria they found themselves in possession of large tracts of the country in and around these states, and greatly desired to annex them altogether. Albert, duke of Austria, in 1298 became king of Germany (often called emperor, though incorrectly, as he was never crowned by the pope), and at once used his imperial power in favour of this long-settled plan. The three forest states (*waldstätter*), Schwyz, Uri, and Unterwalden, formed a league. The legend connects all this with a fine story about Tell, who is put forward as the William Wallace of the rising. Gessler is said to have ruled very tyrannically

over the people whose liberties he had taken, and to have made them bow to the cap of Austria hung up on a pole in Altorf. Tell refusing to bow was punished by being ordered, on pain of death, to amuse the governor by his skill in archery, the target being an apple placed on the head of his son. The trial came off successfully, to Gessler's discomfiture. Tell escaped, and took his revenge by shooting Gessler in the Pass of Küssnacht with the second arrow, which like all bowmen he kept in reserve (1307). So runs the legend. What is true is that Gessler was assassinated; the rest is still disputed.

GES'TA ROMANO'RUM is the title of a very early mediæval Latin collection of tales, so many of which are laid in the times of the empire that the "Acts of the Romans" was the popular title for it. The tales are exceedingly short and pithy, almost in the style of fables; but they enjoyed for centuries an unrivalled popularity, and have furnished poets and playwrights with materials for countless plots. They are, in fact, the Christian analogue to the far finer and more deservedly famous "Arabian Nights" of the Moslems. From certain Anglicisms found in the text it had been long suspected that an Englishman was the compiler of the Gesta Romanorum, and the question seems now to be settled by the exhaustive research of Grässe, one of the best editors and translators of the work (Dresden, 1842). He even names a certain Elimandus as the actual English author of the collection, and the time is the thirteenth century, when the Fabliaux of France were arising as copies of the newly imported fables of Pilpay (Bidpai). The plot of King Lear is taken from this fine old collection of the Gesta Romanorum, where it is told as of Theodosius, "a wys emperour in the citie of Rome." Probably Shakspeare found it in Holinshed, who had it from Geoffrey of Monmouth, both of these altering the "wys emperour" into a British prince, Leir, son of Baldud. In each case the three daughters and their diverse treatment of their father make the story. This is a sample (flattering, it is true) of the kind of "moral stories" of which the Gesta consists. A good selection, in an English dress, was published by Sonnenschein in 1884 (London).

GESTA'TION is the name given to the time which intervenes between impregnation and birth in the Mammalia. In the various mammals the period and the number of young produced at one birth greatly differ. In the human race the period is nine months, and the normal number is one at a birth, though "twins" are not rare, and "triplets" occasionally occur. The rule of one at a birth applies also to many of the higher mammalia as well as to man. Thus the apes and monkeys, the elephant, the hippopotamus, the rhinoceros, the camel, the mare, the cow, and the ass produce but one in general. The periods of gestation are usually long in these cases as compared with other animals. The ape goes seven months, the cow nine months, the mare eleven, the camel twelve, the giraffe fourteen, the elephant twenty months. On the other hand animals producing a numerous litter generally have a shorter period of gestation. Of the prolific Rodentia the rabbit goes but thirty days, the hare forty, the guinea-pig three weeks, the rat four weeks, &c., to the beaver, four months. The fruitful sow takes but four months to produce a litter, and sheep and goats require one month more. The young of the Carnivora are born blind, like those of the rodents; their period of gestation might therefore be expected to be somewhat short. The cat takes fifty-six days, the dog and her congeners sixty-two days (about two months), the lion 108 (three and a half months), the bear no less than 180 (six months). The young of the marsupials being still more imperfect at birth the gestation is yet shorter. The kangaroo, though an animal of considerable size, goes with young only thirty-nine days (though she carries them for a long time afterwards in her pouch), while the little opossum goes but twenty-six.

GE'TA, ANTONI'NUS, younger son of the Emperor Septimius Severus, born about 190, was made Cæsar and colleague with his father and brother in 208. Geta was distinguished by his mildness and affability, and he is said to have reproved his brother for his proneness to shed blood, in consequence of which he incurred his mortal hatred. When Severus died at Eboracum (York), in 211, he named both his sons his joint successors in the empire. The soldiers, who were much attached to Geta, withstood all the insinuations of Caracalla, who wished to reign alone, and they swore allegiance to both emperors. After a short and unsuccessful campaign against the Caledonians the two brothers proceeded to Rome, where they performed the funeral rites of their father. Geta, who was fond of tranquillity, proposed to take Asia and Egypt, and to reside at Antioch or Alexandria; but his mother Julia, with tears, deprecated the partition, saying that she could not part from either of her sons. After repeated attempts of Caracalla to murder Geta he feigned a wish to be reconciled to his brother, and invited him to a conference in their mother's apartment. Geta went, and was stabbed by some centurions whom Caracalla had concealed for the purpose, in 212. His mother Julia tried to screen him, but they murdered him in her arms, and she was stained by his blood and wounded in one of her hands.

GETHSEM'ANE, a small farm situated at the foot of Mount Olivet, about half or three-quarters of a mile from the walls of Jerusalem. It had attached to it a garden or orchard, which was a favourite resort of our Lord and his disciples (John xviii. 2), and which became the scene of his agony on the night before the crucifixion. At the present day two sites are pointed out, one by the Greek Church and one by the Latin; but the latter, which contains eight very ancient olive trees, and is in close association with the subterranean church and sepulchre of St. Mary, has the greatest weight of evidence in its favour. Dr. Thomson casts doubt upon both places, and believes the true site to be unknown.

GET'TYSBURG, a town in Pennsylvania, United States, 35 miles from Harrisburg. Here three days' severe fighting took place in July, 1863, between the invading Confederate army and the Federals. The Confederates were long successful, but were eventually compelled to retire from Pennsylvania and Maryland. The killed and wounded on each side were estimated at about 15,000. A handsome national memorial was erected on the battle-field in 1869.

GE'UM. See Avens.

GÉVAUDAN, a district which formed a part of the old province of Languedoc, and was divided by the river Lot into Haut Gévaudan and Bas Gévaudan. It derived its name from the Gabali, its ancient inhabitants, a tribe of the Visigoths. It now forms nearly the whole of the department of Lozère. Mende was the chief town, and is still the capital of the department.

GEWAND'HAUS (Armoury), a famous hall in Leipzig, the ancient armoury of the town, where are held the concerts which have long been considered the finest expression of the musical art. Many distinguished musicians have conducted them, beginning with the great Bach, and including, among the more recent, Mendelssohn, under whose direction the Gewandhaus concerts attained the summit of their fame. The nearest approach to the Gewandhaus concerts in this country are the orchestral concerts at the Crystal Palace and the Monday Popular Chamber Concerts in London. Probably these do not fall short, each in its department, of the famous German society, but the latter combines both kinds of concerts in the one institution.

GEY'SER is a form of natural fountain which is distinguished by its intermittent character, and by its throwing up columns of heated water, mixed with mud or

steam. Until modern times the phenomenon was thought to exist only in Iceland, and hence the name was derived from an appropriate Icelandic word, *geysa*, to force out with violence. It is now known to occur on a grand scale in Wyoming (United States), in New Zealand, Japan, and other volcanic regions.

The geysers of Iceland are included within a circuit of 2 miles, and there are upwards of 100 of them. They rise through a thick current of lava. The Great Geyser, or principal fountain, rises through a tube 80 feet deep, about 12 feet wide, and expanding into a funnel about 60 feet in diameter. From this jets of water, at a temperature of 180° to 190° Fahr. (or 80° to 90° C.), are emitted at intervals of about six hours, and play for five or six minutes like an artificial fountain, giving off a great quantity of vapour. The eruption is terminated by a violent explosion of steam from below, after which the tube is found empty. The force is very great, shivering rocks and ejecting stones cast into the pipe, and projecting the water to a height of from 80 to 100 feet. While the tube is filling again with boiling water loud noises are heard below, and the ground is slightly shaken. The water in the tube has been found to vary in heat, the temperature and boiling-point rising with the increasing depth, until towards the bottom the latter is said to be sometimes as much as 261° Fahr. (or 127° C.) The circular reservoirs into which the jets fall are lined with a kind of opal, and the edges are incrusted with silicious sinter of white and brown colours. Soda has been found by analysis to be present in the water; it promotes the solution of the silex, which is insoluble in water without an alkali; and on reaching the air a decomposition takes place, partly by cooling and evaporation, and partly by the action of carbonic acid, which unites with the soda, and the silex is deposited. Grasses and Equisetaare found thickly incrusted with this substance, and leaves and stems of the birch tree, though it does not now exist in the surrounding country. Some of the smaller geysers are used by the Icelanders for cooking their food, and huts are built over them to form steam baths.

The geysers of Wyoming are situated in the Yellowstone Park, and are on a stupendous scale, one of them, the "Giantess," throwing a thin spire of water to a height of 250 feet. The "Castle" also, while the usual height of its column is from 10 to 15 feet, occasionally reaches a like elevation. Several other fountains are from 100 to 200 feet in height. Those of New Zealand are in the south of the province of Auckland, but though very numerous, and depositing large quantities of silica, they do not attain to more than 85 feet.

Geysers are found only in volcanic districts, and their formation may be explained as follows:—The rain, melted snow, &c., percolates through the rocks, and accumulates in underground fissures at a considerable depth. At some part of its course it comes in contact with hot lava, and is partially converted into steam, which exerts sufficient pressure to drive the rest of the water up the narrow fissure or pipe of the geyser to the surface. Any accumulation of pressure causes the water to be driven up more rapidly and to a greater height, and also enables the pent-up steam to escape to the surface. The intermittent eruptions have been explained in various ways, but probably no one explanation will suffice for all cases. In some instances the pressure exerted by the upper part of the column of water in the pipe or neck of the geyser causes the water in the lower part to be heated much above its ordinary boiling-point without being converted into steam. After a time, when the temperature rises sufficiently high to overcome the effect of the superincumbent pressure, there is a sudden generation of steam, which violently forces out the water in the form of a jet, and completely empties both the pipe and the basin.

GHATS or **GHAUTS** (meaning etymologically "a pass through a mountain" or "landing stairs from a river," in this case the passes or landing stairs from the coast to the inner plateau), two ranges of mountains, forming the eastern and the western walls which support the triangular table-land of Southern India. The Eastern Ghats run in fragmentary spurs and ranges down the Madras side of India, receding inland, and leaving broad tracts between their base and the coast. The Western Ghats form the great sea-wall for the Bombay Presidency, with only a narrow strip between them and the shore. At one part they rise in magnificent precipices and headlands out of the ocean, and truly look like colossal "landing stairs" from the sea. The Eastern and the Western Ghats meet at an angle near Cape Comorin, and so complete the three sides of the interior table land. The inner plateau itself lies far below the snow-line, and its ordinary elevation seldom exceeds 3000 feet. The entire geography of the two coasts of the Indian Peninsula is determined by the characteristics of these two mountain ranges. On the east the country is comparatively open, and everywhere accessible to the spread of civilization. It is here that all the great kingdoms of Southern India have fixed their capitals. Along the west only a narrow strip of lowland intervenes between the barrier range and the sea-board. The inhabitants are cut off from communication with the interior, and have been left to develop a civilization of their own. Again, the east coast is a comparatively dry region. Except in the deltas of the great rivers, the crops are dependent upon a local rainfall, which rarely exceeds 40 inches in the year. The soil is poor, the general elevation high, and the mountains are not profusely covered with forest. In this region the chief aim of the forest department is to preserve a sufficient supply of trees for fuel; but on the west all these conditions are reversed. The rivers are mere hill torrents, but the south-west monsoon brings an unfailing rainfall in such abundance as to clothe even the hill slopes with a most luxuriant vegetation. The average all along the coast from Khandesh to Malabar reaches 100 inches, and in many exceptional spots high up among the mountains more than 200 inches of rain are registered every year.

GHAZIPUR', a British district in the lieutenant-governorship of the North-western Provinces of India, with an area of 2167 square miles, and a population of 1,400,000. Ghazipur is a district in the Benares division. It is bounded on the north by Azamgarh nad Saran, on the west by Benares and Jaunpur, on the south by Shahabad, and on the east by Saran. The district forms part of the great alluvial plain of the Ganges, and stretches in equal portions on either side of the sacred river. No hill or natural eminence is to be found within the district on either side; but both north and south of the Ganges the country may be divided into an upland and a low-lying tract. In high floods the Ganges and its great affluent the Gogra join their waters, sweeping across the entire delta inclosed between their beds. On such occasions the villages, raised on artificial embankments, stand out like islands in the midst of an inland sea; but when the floods have subsided stagnant pools collect in the pits from which the embankments were taken, thus rendering the population sickly and feeble. The greater portion of the cultivable soil in Ghazipur is fully tilled. The black earth, called *kharril*, resembling the mar of Bundelkhand, is common in the lowlands and in the plateau south of the Ganges. It produces a good spring crop without irrigation, but its character is much improved if sand is spread over the surface; otherwise it is liable to dry up into deeply-fissured masses of hardened clay.

GHAZIPUR, the administrative headquarters of the above district, is situated on the low alluvial northern bank of the Ganges, 64 miles north-east of Benares, and has a population

of 40,000. The Palace of the Forty Pillars, built by Sheikh Abdulla, governor under the Oudh viceroys, now lies in ruins. There is a monument to Lord Cornwallis, who died here in 1805, consisting of a quasi-Grecian building with a marble statue by Flaxman. Ghazipur has a trade in sugar, tobacco, coarse long-cloth, and rose water. It is also the headquarters of the government opium department, where all the opium from the North-western Provinces is collected and manufactured under a monopoly.

GHEE, the famous Indian clarified butter which anoints the unchanging rice-diet of the poorer native, usually made from buffalo's milk. The milk is boiled and then set aside to cool; when cool, a little sour milk causes it to "turn." The whole mass is then churned, a little hot water being added, till the butter "comes." The butter is allowed to become rancid, and is then clarified by boiling with sour milk and salt. It will then keep a long time if properly put up in closed vessels; but it has, as may be imagined, a peculiar taste, delicious to the Indian palate, but rather nauseous to a European.

To us it seems strange to think of cultivating a taste for rancid butter, though these people drink off a cup of melted ghee as a *bonne bouche*. But when we consider the state in which epicures prefer to eat game among ourselves, or the manner of preparation of the partly fermented *sauerkraut* of Germany, we may have less contempt for the Indian preference in butter.

GHENT (French *Gand*), the capital of East Flanders, in Belgium, stands at the intersection of the railways directly connecting Ostend and Malines, Antwerp, and Lille, from which towns it is distant respectively 38, 33, 32, and 42 miles. The city is at the confluence of the Scheldt and the Lys, and is intersected by a great number of navigable canals, which communicate with those rivers, and thus form twenty-six islands, connected with each other by 309 bridges. Ghent is a station of the railway from Ostend to Cologne, and at the head of a branch railway by Paris to Lille, 30 miles west-north-west of Brussels.

Ghent is a handsome well-built city, and in 1882 had 133,755 inhabitants. It is surrounded by walls, and has seven gate-entrances; of these the Antwerp Gate is much admired for its architecture. The houses are in general picturesque, from the variety of their gable ends, and from the carving upon them. There are several fine promenades in the city. The finest runs along the Coupure, a canal cut in 1758 to connect the Lys with the Bruges Canal, and consists of a double avenue of large trees. The boulevards which surround the city are also much used as public walks. The Marché-au-Vendredi (Vrydags Markt, or Friday market) is a large square, with a very old tower. A handsome statue of Jacques Van Arteveld was erected at Ghent in 1863.

The Cathedral of St. Bavon, a fine Gothic edifice, was consecrated in 941. Its rebuilding was undertaken in the thirteenth century, but was not entirely finished until the beginning of the sixteenth century. The tower is remarkable both for its elegance and its height, which is 271 feet. The grand altar and the twenty-four chapels in this cathedral are ornamented with fine paintings, among which are masterpieces by Verbruggen and Rubens, and the celebrated "Adoration of the Spotless Lamb," by the Van Eycks (date 1432). The Church of St. Michael, situated in the centre of the city, on the banks of the Lys, is built in a light and delicate style of architecture. It contains Vandyck's celebrated picture of "The Crucifixion." The most ancient church in the city is that of St. Nicholas, which, like all the others, contains paintings and sculptures of considerable merit. The Hotel de Ville is a striking building with two façades, one built in 1482, in Moresco-Gothic; the other, which faces the butter-market, built in the early part of the seventeenth century, is in a mixed style. Near this is the *beffroi*, or belfry tower, built in 1183, on the top of which is the gilt dragon, originally brought from the Church of St. Sophia at Constantinople, and the trophy of the victory of the inhabitants of Ghent, under Van Arteveld, over those of Bruges in 1382. The university, a handsome modern edifice, was founded in 1816. It has a portico with eight Corinthian columns, copied from those of the Pantheon in Rome. The building is large and commodious, and is well furnished with philosophical apparatus and specimens of natural history. The library contains about 100,000 volumes. There is a botanic garden attached to the university. The number of students ranges between 300 and 400. The Royal College of Ghent occupies the greater part of the ancient abbey of Baudello, a vast building in which several of the students as well as the professors reside. The Royal Academy of Drawing, Painting, and Architecture occupies the ancient college of the Augustines, and is attended by great numbers of students.

Ghent contains twenty-one public hospitals, besides several private establishments for benevolent purposes. The celebrated convent of the Beguins is described under BEGUINS.

About 25,000 persons are employed in spinning, weaving, bleaching, and printing cotton. In 1801 a clever Fleming, named Lieven Bauens, brought over from Manchester English workmen and spinning jennies, and the manufacture quickly took root. Sugar refining is carried on to a large extent in several establishments. Among the various other manufactures are those of lace, silk-weaving, salt-refining, paper-making, woollen cloths, tanning, bleaching, soap-boiling, and pin-making. There is a large and active trade in agricultural produce.

The origin of Ghent dates traditionally from the irruption of the Vandals into Belgium in the fifth century. They built here the town or fort *Vanda*, afterwards called *Ganda*, or *Gandavum Castrum*. This tradition receives confirmation from the existence of the fort still called Wandelaers Kasteel (Vandals' Castle), on the left bank of the Scheldt, within the city. About the year 629 St. Amand converted the inhabitants from paganism, and he founded two monasteries.

In 868 Baldwin Iron-Arm, the first count of Flanders, built a fortress at Ghent, which was called Count's Castle. In 879–80 the Danes under Hastings, repulsed from England, plundered the town, and obtained an immense booty. In the year 968 Baldwin the Younger, count of Flanders, introduced the art of weaving.

About the end of the twelfth century the city became in a great measure independent of its nobles; it had its own municipal government, elected its sheriffs, adopted a seal, and joined the association of the Hanse Towns. The charter of the city, granted by Count Baldwin of Hainault, dates from 1180, at which time Ghent became the capital of Flanders. By the prosperity consequent on its manufacturing industry, the city increased so rapidly that towards the end of the thirteenth century it exceeded Paris in extent and population. In the fourteenth century its importance increased, though the tumultuous proceedings of its inhabitants under the two Van Arteveldts must have been a considerable drawback. At the beginning of the fifteenth century the number of its citizens employed in the manufacture of woollens is said to have amounted to 40,000, who in times of war furnished from their number 18,000 armed men. The Emperor Charles V. was born at Ghent, in February, 1500. During his reign the city had a population of 175,000, and probably covered more ground than any other in Western Europe, whence the boast of the emperor, playing on the name, "that he could put Paris in his glove" (*gant*). In 1537 the citizens resisted the payment of an extraordinary subsidy, but were speedily reduced to submission, and the emperor deprived them of most of their privileges.

When the confederation was formed for expelling the Spaniards from the Belgian provinces, a congress was held in Ghent; and "the pacification of Ghent" was publicly signed by the confederates in the town-hall, 8th November, 1576, and on the 11th the Spanish garrison capitulated to the citizens. This citadel was afterwards destroyed.

In 1745 Louis XV., having entered Flanders with Marshal Saxe at the head of 100,000 men, took Ghent by surprise; but the country soon again came into possession of Austria. On the downfall of Napoleon in 1814, Flanders became part of the kingdom of the United Netherlands. In 1814 the treaty of peace was signed here between Great Britain and the United States of North America. In 1830, on the separation of Belgium from Holland, it became a part of the former kingdom.

In addition to Charles V. Ghent was the birthplace of John of Gaunt, son of Edward III.; the popular leader, Jacques Van Arteveld, the "brewer of Ghent," and his son Philip; Heinsius the critic; and the sculptor Delvaux.

GHIB'ELLINES, the imperialists in the long mediæval contest between the empire and the Holy See which desolated Central Europe and particularly Italy. The name arises from *Waiblingen*, the birthplace of Frederick, brother and general of the Emperor Conrad (elected 1138), and was adopted as the battle-cry of his followers against those of Welf, uncle and general of Henry the Lion, duke of Bavaria, hereditary enemy and opponent of Conrad. Count Welf in his eagerness to vex the imperialists was hand and glove with the clergy; "a Welf" against "a Waiblingen" therefore soon came to mean church against empire. *Guelf* and *Ghibelline* are the Italianized forms of the words. See also GUELF.

GHIBER'TI, LORENZO. This eminent sculptor, whose life makes an epoch in the history of Italian and modern art generally, was born at Florence in 1378, where his step-father Bartoluccio instructed him in drawing and in all kinds of ornamental working in metals. Ghiberti also practised painting in his youth. He had just completed a fresco in the palace of Pandolfo Malatesta at Rimini, in 1401, when a competition was opened at Florence for the design of a second pair of large gates to the Baptistery, worthy of those previously executed by Andrea Pisano about 1330. From among the multitudes of artists who competed, seven were chosen to make trial on a given subject, the sacrifice of Isaac, and Ghiberti was one of the seven. Of the designs produced, only those of Ghiberti and Brunelleschi have been preserved; and Brunelleschi was so well pleased with the excellence of the design of his rival, that he solicited that the sculptures for the gates might be left solely to Ghiberti. These doors, which contain twenty compartments or panels, filled with as many reliefs consisting of scriptural subjects, besides a profusion of ornamental work in the intermediate spaces, drew from Michael Angelo the eulogium that they were worthy to be the gates of Paradise. Ghiberti executed for the same building a third and still more elaborate pair of bronze doors, representing in relief various subjects from the Old Testament. The history of these two pairs of gates is practically the history of the man's working life, for he spent on their production no less than fifty years—a lifetime well spent, as no words can do justice to their wonderful beauty and technical skill in execution. The two are very dissimilar—the earlier northern pair are simple in design and thoroughly sculpturesque in treatment; the later western pair, with their compositions of many figures in each panel, and their wonderful effects of receding planes and distances, to some extent verge upon the domain of painting. Each little figure, each small bust which decorates the framework of the large panels, is a studied and finished work of art in itself; and yet they are but little noticed in the general mass of splendour. There is a very fair reproduction of this in the South Kensington Museum, where the details can be easily examined. No one should omit to notice the wonderful little portrait busts of Ghiberti himself and his step-father Bartoluccio. Among his other works may be mentioned the admirable bronze relief in the Duomo at Florence, representing San Zenobio bringing a dead child to life, and the three bronze statues of St. John the Baptist, St. Matthew, and St. Stephen, at the church of Or San Michele in the same city. His death is supposed to have occurred soon after 1455. An excellent brief account of this artist, whose work exercised an immense influence over art, appeared in London in 1882 (Great Artist Series).

GHIL'ZAIS, one of the most important tribes of Afghanistan, and, with the exception of the Duranis, the most powerful of all the tribes inhabiting that country. They occupy the district lying between the frontier of India on the east, the Gulkoli range on the west, the Cabul River on the north, and Khelat-i-Ghilzai on the south. Broadfoot estimated their numbers at 100,000 families; more recent authorities have given the strength of the clan as 100,000 men. Though generally regarded as Afghans the Ghilzais are undoubtedly a mixed race, their appearance justifying the belief that they are of Turkish origin. There is a tradition, borne out by many prevailing customs, that they were formerly Christians of the Armenian and Georgian churches. They were originally a pastoral race, and many sections of the tribes still retain their nomadic habits. They appear to be a nation of families submitting to their natural heads, but having no common leader, their one bond of union being their language and their alleged descent from one common stock. Physically the Ghilzais are a remarkably fine race of men, being unsurpassed by any Afghan tribe in strength and commanding stature. They are brave and warlike, with a sternness of disposition amounting to ferocity, and often degenerating to brutality. They have ever shown the most fanatical hatred towards the English, were our most formidable foes in the disasters of 1839-42, and but little less so in the Afghan difficulties of 1878-80.

GHIRLANDA'JO. *Domenico Bigordi*, called *Del Ghirlandajo* (son of the garland-maker), from the profession of his father, was born at Florence in 1449, and died in 1494. He was fertile in invention, and later artists often made use of his works. He was one of the first who, with some correctness of outline, gave character to the face, and was the first Florentine whose works evince a due knowledge of perspective. Ghirlandajo may be said to have carried on the movement begun by Masaccio. He excelled his contemporaries in brilliancy of colouring, especially in fresco, and was a complete master of all the technical processes of painting. His finest frescos are in the Church of the Trinity at Florence. His brothers, David and Benedetto, were not equal to him. His son Ridolfo, who died in 1560, aged seventy-five, was a pupil of Fra Bartolommeo and a friend of Raphael, some analogy with whose genius, but with inferior powers, may be traced in his pictures. Ghirlandajo numbered among his pupils the celebrated Michael Angelo.

GHI'ZEH, a town and province of Middle Egypt, on the west bank of the Nile, the former being 3 miles S.W. from Cairo. The place is noted as the spot where the great pyramids commence, the largest of these being that attributed to Cheops, 763½ feet square at its foundation, covering 13 acres, and 460 feet in height. Ghizeh consists now of only a few miserable cafés and wretched bazaars, though once it boasted of the summer palaces, fruit-gardens, and kiosks of the Mamaluke sultans. Like all other Egyptian villages, the houses are almost all built of mud, or mud made into sun-dried bricks. It is still famous on account of the extensive ovens in which eggs are hatched by artificial heat, and which have existed there for many centuries.

GHAZ'NI or **GHUZ'NEE,** a celebrated city of Afghanistan, 85 miles S.S.W. of Cabul, and once the capital of an empire reaching from the Tigris to the Ganges. It was then adorned with the most splendid buildings in Asia, but is now reduced to about 1500 mean dwellings. Some remains of its ancient grandeur are still to be seen in its neighbourhood, among them the tomb of Sultan Mahmud, the conqueror of India. The large sandal-wood doors were brought as a trophy from the temple of Somnauth in Guzerat, and were again removed from Ghazni, by order of Lord Ellenborough, in 1842. In the unsettled state of Afghanistan in 1880 it was alternately the headquarters of contending tribes, until occupied by General Stewart in April of that year. Owing to the height of the town above the sea, though it is situated in 68° 18′ E. lon. and 33° 34′ N. lat., the thermometer registers 20° Fahr. below zero in winter. The empire of which Ghazni was the capital was founded by Sebuctaghi in 975, and lasted under thirteen successive sovereigns till 1171, when the city was conquered by Mohammed Ghoree, and burned.

GHOST-MOTH (*Hepialus humuli*), a species of MOTH belonging to the family Hepialidæ. It is well known in hop districts as the species whose caterpillar, the *otter*, is so destructive to the roots of the hop plant. It, however, also feeds on the roots of other plants. The male is white above and brown beneath. The wings of the female are yellowish, spotted with red. These moths fly about in the twilight with a peculiar hovering flight. The wings are very long and narrow, while the antennæ are very short.

GIANT (Gr. *gigas*), a man of great or abnormal stature. It is a common opinion that in the earlier ages of the world men in general possessed superior physical powers, and were of a greater size than they are at present; and this notion seems to have been even more prevalent in ancient times than it is at present. Pliny observes (vii. 16) that "the whole race of mankind is daily becoming smaller." Homer more than once makes a very disparaging comparison between his own degenerate contemporaries and the heroes of the Trojan War. But all the facts and circumstances which can be brought forward on this subject tend to convince us that the human form has not degenerated, and that men of the present age are of the same stature as in the beginning of the world. In the first place, though we read both in sacred and profane history of giants, yet they were at the time when they lived esteemed as wonders. All the remains of the human body (as bones, and particularly the teeth) which have been found unchanged in the most ancient urns and burial-places demonstrate this point clearly. The oldest coffin in the world is that found in the Great Pyramid of Egypt, and Mr. Greaves observes that this sarcophagus hardly exceeds the size of our ordinary coffins, being scarcely 6½ feet long. From looking also at the height of mummies which have been brought to this country, we must conclude that the people who inhabited Egypt 2000 or 3000 years ago were not superior in size to the present inhabitants of that country. Lastly, all the facts which we can collect from ancient works of art, from armour (as helmets and breastplates), or from buildings designed for the abode and accommodation of men, concur in strengthening the proofs against any decay in nature. That man has not degenerated in stature in consequence of the effects of civilization is clear, because the inhabitants of savage countries—as the natives of America, Africa, Australia, or the South-Sea Islands—do not exceed us in size.

The notion of the existence of giants in former times has, in many instances, been founded on the discovery of the bones of large animals belonging to extinct species, which have been ascribed to human subjects of immoderate stature. (See the story in Herodotus, i. 68.)

In modern times the people who have excited the most curiosity and given rise to the most conflicting statements are the Patagonians. The first navigators by whom they were observed represented them as being of colossal stature; but though more recent and accurate accounts describe them as being very tall, yet the tallest do not much exceed 7 feet.

That no man ever existed of the height of more than 9 feet may be supposed from what is to be seen at present, and from the deviations which occur in the ordinary course of nature in animals. Several individuals, measuring from 7 to 8 feet and upwards, have been exhibited in this country. The most celebrated, whose skeleton is in the museum of the Royal College of Surgeons in London, was Charles Byrne, who went by the name of O'Brien; he died in 1783 at the age of twenty-two, and measured 8 feet 4 inches. The skeleton is 8 feet 2 inches in height.

We may remark that those individuals who deviate greatly from the common standard, either one way or the other, are generally neither well proportioned nor healthy. The head in giants is commonly too small for the rest of the body, and in dwarfs too large. Giants are as commonly wanting in courage as dwarfs are impertinently bold. See DWARFS.

In endeavouring to account for the diversities of stature which occur, we must make an observation which is equally applicable to differences of colour, features, and other particulars, in which individuals and particular races differ from each other, namely, that the law of resemblance between parents and offspring, which preserves species and maintains uniformity in the living part of creation, undergoes only occasional and rare deviations, and those only to a limited extent. It only remains to be added that giants form part of the mythology of nearly every nation.

GIANTS' CAUSEWAY, a remarkable columnar basaltic formation on the northern coast of the county of Antrim, in Ireland, situated about midway between the towns of Ballycastle and Coleraine. The trap district with which this formation is connected occupies almost the whole of the county of Antrim and a considerable portion of the eastern part of Londonderry, comprehending an area of about 800 square miles on both sides of the valley of the Bann. Throughout this area the basalt is found capping all the eminences, and constituting the general superstratum, in beds of an average thickness of about 500 feet. Beneath the basalt occur a series of secondary formations peculiar to this area, consisting, in descending order, of thick beds of indurated chalk, the white limestone of Antrim, succeeded (unless where the series is broken) by mulatto or green sandstone reposing on blue argillaceous limestone, which again rests on the red sandstone of the coal formation that appears to underlie the greater part of the basaltic tract.

The mass of basalt is considerably thicker towards the northern extremity of the area, and it is here chiefly that the series of columnar formations occur. There are three distinct beds of such formations, the uppermost of which is distinctly observable at Fair Head, on the north-east extremity of the coast, and the same formation appears occasionally to recur along the verge of the precipice which trends westward to Dunseverick, at a short distance from which the two lower beds emerge from the sea, and, rising along the escarpment of the rock, form colonnades of the most striking appearance for a distance of nearly 3 miles, when the upper one is lost in the surrounding masses of basalt, while the lower stratum sinks again under water, its denuded extremity forming that particular group of columns known as the Giants' Causeway.

It is observable that the dimensions of the columns diminish, and the perfection of their structure increases, as the strata descend. Thus the most perfect arrangement

is found in the lowest stratum, of which arrangement the Giants' Causeway affords the most perfect specimen. The upper part of the stratum, being here denuded for a distance of about 300 yards, exhibits an irregular pavement formed of the tops of polygonal columns, so closely arranged that the blade of a knife can with difficulty be inserted in the interstices. The columns are chiefly hexagonal, but polygons of five, seven, and eight sides are of frequent occurrence. These columns are divided into joints of unequal length; each joint is formed by the adjacent extremities being relatively convex and concave. The stone is the most compact and homogeneous variety of basalt. The entire mass of these columns, of which about 30 feet are exposed above the surrounding shingle at the highest point of their denudation, bears a strong resemblance to an artificial mole projecting from the base of the cliff into the sea.

Along the coast at Ushet-haven, Roanscarave, and Thivigh, are several smaller causeways nearly as perfect as the one described. The columnar strata of the islands of Rathlin and Staffa indicate the extent of the same formation northward and eastward. The vicinity of the Giants' Causeway affords numerous appearances confirmatory of the opinion that the basalt when superinduced over the secondary strata was in a state of fusion from heat; such are the conversion of old red sandstone into hornstone, the conversion of clay slate into flinty slate, the conversion of coal into cinders, and in numerous instances the conversion of chalk into granular marble, all arising from the contact of trap dykes with the altered strata. A natural phenomenon possessing so close a resemblance to human workmanship was sure to appeal vividly to the imagination of an uncivilized race, and all kinds of myths have been attached to the Giants' Causeway and its different parts. The name arises from the legend that Fingal and his gigantic brethren constructed a magnificent causeway to Scotland, of which this is one of the remaining buttresses, the isle of Staffa being another.

GIANTS KETTLES are deep cavities or pot-holes that occur in the rock-surfaces of glaciated districts. They are evidently represented in the districts of existing glaciers by the MOULINS, and were produced by a similar process, namely, the fall of water—containing stones, sand, and mud—down a crevasse; as the crevasse remained stationary, the water falling constantly on the same spot excavod the hole. Giants' kettles are therefore considered to be evidences of past glacial conditions.

GIAOUR, a term applied by the Turks to all who reject Mohammedanism, and especially to European Christians. It signifies unbeliever, and was formerly a term of reproach. Lord Byron wrote a poem entitled "The Giaour" in 1813. As the word has an odd look it may be as well to add that Byron makes giaour rhyme to *hour*, *bower*, *power*, &c. Giaour is an Italianized spelling of the Turkish *jawr* (Persian *gawr*), used by the Franks of the Levant. All these are corruptions of the Arabic *kafir*, an infidel; *kafr*, to deny God.

GIBBON (Hylobates) is a genus of anthropoid apes confined to the south-east of Asia and the Malay Archipelago. The gibbons, as their name, long-armed apes, denotes, are remarkable for the length of their fore limbs; when the body is erect the fingers can touch the sole of the foot, and in some species the whole palm of the hand can be applied to the ground. The gibbons agree with the other man-like apes in having no tail, but differ from them in having callosities, naked callous patches, on the buttocks. The disproportion between the length of the body and that of the legs, so conspicuous in the chimpanzee or orang-outan, is not so marked in the gibbon; in this respect a nearer approach is made to human symmetry than in any other ape. The palms of the hands and feet are naked; the thumb is cleft very low down, so that the metacarpal joint is not included in the palm of the hand, and the thumb thus appears to consist of three joints; the first and second toes are more or less united, and this is also sometimes the case with the second and third. The skull is small and man-like, the facial portion being small in comparison with the cranial. The brain is small. The canine teeth are elongated and tusk-like. With one exception—that of the siamang—the gibbons are destitute of the large sacs appended to the windpipe which occur in the other anthropoid apes. The number of ribs varies from twelve to fourteen.

The general habits of the gibbons appear to be rather sedentary than otherwise. Their movements are slow; their nature gentle, and rather melancholy; and they do not appear to lose their mildness of disposition so much as the other apes as they increase in age. They live in troops in the forests, and usually raise a tremendous howling noise in concert in the morning and evening. They display wonderful agility among the trees, their long arms enabling them to swing from bough to bough. The voice of some of the species is not unmusical. They feed on fruits and insects. The species are not very numerous. The first species that was accurately described and figured was the White-handed Gibbon (*Hylobates lar*), a native of Tenasserim. This animal, which is between 2 and 3 feet in height, is of a uniform black or brownish-black colour, with the exception of the backs of the hands and feet and a broad band encircling the face, which are whitish. The black hair of the body and limbs is erect and woolly; the white hair of the hands and feet is coarse, harsh, straight, and depressed. Variations in the general colour sometimes take place. These gibbons live in companies of from eight to twenty. Another species, the Agile Gibbon (*Hylobates agilis*), is more frequently met with in pairs. As its name conveys, this species is remarkable for its agility. This gibbon is a native of Sumatra. The largest and most interesting species is the SIAMANG (*Hylobates syndactylus*), which differs anatomically in several respects from the other species. The HOOLOCK (*Hylobates hoolock*) is another large species inhabiting Assam.

Pliny's reference to satyrs living in the East Indies is probably founded partly upon the imperfect accounts of gibbons which had reached him. Thus he says, that "Tauron mentions a savage tribe, under the name of Choromandæ, which have no speech, but utter horrid screams; they have hairy bodies, fiery eyes, and teeth like dogs;" and adds that "Megasthenes relates that among the nomad Indians there is a tribe which, instead of a nose, have only two holes; they have bandy legs, which they can twist about like snakes, and are called Scyritæ." Marco Polo states that the inhabitants of Java were in the habit of shaving and embalming the bodies of gibbons, which they then sold as pigmies to the merchants who visited their coast in search of drugs and spices. This was probably done in times still more anterior, and it may have been by such means that the ancients became aware of the existence of these so-called satyrs.

GIBBON, EDWARD, an eminent historian, was born at Putney, in Surrey, 27th April, 1737. He has given us in his "Autobiography," which was published after his death by Lord Sheffield, copious particulars concerning his life and writings. Being a delicate child his education was chiefly conducted at home under his aunt, Mrs. Porten; and when he went to Westminster School in 1749 his weak health prevented any severe study. After residing a short time with the Rev. Philip Francis, the translator of Horace, he went to Magdalen College, Oxford, as a gentleman commoner, in his fifteenth year, with a stock of erudition (from his own private desultory reading) that "might have puzzled a doctor, and a degree of ignorance of which a schoolboy might have been ashamed." At Oxford again he made little orderly progress, and he was

compelled to leave it in 1753, through his conversion to the Roman Catholic faith. His father then sent him to M. Pavillard, a Calvinist minister at Lausanne, where Gibbon returned to the Protestant church, and devoted himself assiduously to regular study. His first work (written in French), "Essai sur l'Étude de la Littérature," appeared in 1761. On his return to England he was appointed captain in the Hampshire militia, and paid much attention to his duties. In 1774 he was returned to Parliament for Liskeard through the interest of Lord Eliot, and supported the North ministry, which in return conferred on him a commissionership of trade and plantations. In the next Parliament he sat for Lymington. On the dissolution of the North ministry he lost his place. In 1776 appeared the first volume of his great work, the "Decline and Fall of the Roman Empire." The idea of this work had occurred to him during a visit to Rome in 1764, while listening to the barefooted friars as they sang their vespers in the temple of Jupiter. Its success was decisive. The other volumes followed in 1781 and 1788. From 1783 to 1793 Gibbon resided chiefly at Lausanne with his friend M. Deyverdun. He returned to London in 1793, where he died, 16th January, 1794.

The "Decline and Fall of the Roman Empire" comprises the history of the world for nearly thirteen centuries, from the reign of the Antonines to the taking of Constantinople by the Turks; it includes also the history of the Christian church. For this portion he was attacked as an assailant of the divine authority of Christianity; but it was not until "not the faith, but the fidelity of the historian" was attacked, that Gibbon defended himself in his "Vindication." The "Decline and Fall" has been translated into almost all European languages, and Niebuhr declares it to be the greatest achievement of human thought and learning in the department of history ever accomplished. Perhaps the best modern edition is that published by Dr. W. Smith (eight vols. 8vo, 1854 and 1872), which is enriched with the corrections, comments, and notes of Milman, Guizot, and others. Gibbon wrote various other works, most of which were collected and published in his "Miscellaneous Works," edited by Lord Sheffield, in five vols. 8vo. ("Memoirs," by J. C. Morison, London, 1879.)

GIBBONS, GRINLING, an artist celebrated for the extraordinary taste and delicacy of execution he displayed in wood-carving, was born in 1648 in London, or according to some, in Rotterdam. Having been recommended by Evelyn to Charles II., the king bestowed upon him a place in the board of works, and employed him in the chapel of Windsor, where he executed much of the ornamental carving, consisting of such emblematic objects as doves, pelicans, palm branches, &c. His other chief works of this kind are in the choir of St. Paul's, at Chatsworth, Southwick in Hants, and in a room at Petworth. All these works are merely ornamental, and analogous to what is termed still-life in painting; yet that Gibbons had talents for those of a higher character is proved by his statue of James II., behind the Banqueting House, Whitehall. He died 3rd August, 1721.

GIBBONS, ORLANDO, was born at Cambridge in 1583. At the age of twenty-one he became organist of the Chapel-royal, London. In 1625, attending officially the ceremonial of the marriage of Charles I., for which occasion he composed the music, he took the small-pox, and died on the Whitsunday following. He left a son, Christopher (1615–76), who at the Restoration was appointed principal organist to the king and to Westminster Abbey. He was celebrated for his organ playing, and is said to have instructed Dr. Blow on this instrument. Orlando had also two brothers, Edward, organist of Bristol, and Ellis, organist of Salisbury. The services, anthems, and madrigals of Orlando Gibbons are held in the highest estimation by scientific musicians.

GIB'EON was a celebrated city of ancient Palestine, about 5 miles north-west of Jerusalem. On the settlement of the Israelites in Canaan it escaped the fate of the other Canaanitish cities by a stratagem, on the discovery of which the people of the city were made "hewers of wood and drawers of water" to all the congregation of the chosen people. On a hill in or near this town the tabernacle was stationed for some time. The word is equivalent to *Gibeah.*

GIBRAL'TAR, a town and fortified rock in the most southern part of Spain, belonging to Great Britain. The rock, which is connected with the continent by an isthmus of low sand, and almost wholly surrounded by the waters of the Mediterranean, forms a promontory 3 miles in length from north to south, with an area of nearly 2 square miles. The width is irregular, but the entire circumference is about 7 miles. Towards the south it terminates in a point, called Europa Point. This rock, under the name of *Calpe*, and *Mount Abyla* (now called Ceuta), opposite to it on the African coast, were called by the ancients the Pillars of Hercules, and in very early ages were regarded by the people dwelling to the east of them as the western boundary of the world. Its name was changed to *Gibel-Tarif* (mountain of Tarif) in the beginning of the eighth century, when Tarif Ibn Zarca landed with a large army to conquer Spain, and erected a strong fortress on the mountain side. During the Moorish occupation of Spain it increased in importance, but was at length taken by Ferdinand, king of Castile, in the fourteenth century. It was soon recaptured, and did not become the appanage of Spain till 1462. The Spaniards held it from 1462 to 1704, when it was taken by an English and Dutch fleet. The Spaniards made unavailing attempts to regain it in the next few succeeding years, and again in 1727; but the most memorable siege lasted from 1779 to 1783, during which General Elliot (afterwards Lord Heathfield) successfully resisted the combined armies and fleets of France and Spain. Gibraltar has since remained in the possession of the English.

The rock, of which the greatest elevation is 1439 feet, consists principally of a gray compact marble. It abounds with caves, the most remarkable of which is St. Michael's, on the south-west side. In the perpendicular fissures of the rock bones of various animals, including human bones, have frequently been discovered. The natural productions of Gibraltar are wild rabbits, snakes, woodcocks, teal, and partridges. The numerous caves also form retreats for troops of the Barbary ape (*Macacus inuus*), the only species of the monkey tribe found in Europe, and inhabiting only this rock, where it is under the special protection of the garrison, else it would be speedily exterminated. The climate is temperate during the greater part of the year, and even in the summer months the excessive heat is allayed by a refreshing sea breeze that sets in during the forenoon and continues till sunset. There are no springs of fresh water on the rock, and the inhabitants are therefore dependent for their supply on rain and artificial means of obtaining water for drinking purposes. On whichever side it is approached, it has a barren and forbidding appearance. The east and north sides are, from their steepness, wholly inaccessible. Towards the south it is also very precipitous, but on the west side, on the lower part of which the town is built, it gradually declines towards the bay, where the strength of the fortifications is such that the fortress appears to be impregnable. Besides the fortifications there are two excavations, wrought with extreme labour, in the solid rock, called galleries, which extend from 2 to 3 miles in length, and are of sufficient width for carriages. Along these galleries, at intervals of every 12 yards, are port-holes bearing upon the neutral ground and upon the bay. The Spanish lines, which extend across the isthmus, are

defended by two forts, the principal of which is called St. Philip. The space between these lines and the foot of the rock is called the *neutral ground*, and it is here that the lazaretto is situated. The town is built on a bed of red sand, near the foot of the north-west side of the hill. It is paved and well lighted, and consists chiefly of one street, extending about a mile in length from South Port to Water Port. The principal buildings are the governor's and lieutenant-governor's houses, the Admiralty (formerly a monastery of White Friars), the barracks, victualling office, and store-house, the Spanish church, Jews' synagogue, the cathedral, exchange, with libraries, club room, and news-room, the south barracks, and navy hospitals. There are also a Roman Catholic church, Wesleyan chapel, Scotch church, and subscription schools. The town can be called neither clean nor neat, but has been much improved. The houses are built in the English style, but with little regard to their ventilation. A bishopric of Gibraltar was created in 1842. In 1867 some alterations in the fortifications and the construction of a breakwater were found to have so seriously affected the sanitary state of the town that a new system of drainage was carried out in 1868-70 at a cost of £10,000. At the north of the town are Elliot's Gardens, which are well laid out, and form a pleasant promenade. They contain a bronze statue of General Elliot, the defender of Gibraltar in 1782. During the summer the troops are placed under tents in the neutral ground, and are plentifully supplied with provisions by the Spaniards.

The population of the town at the census of 1881 was 18,381, excluding the garrison, which ordinarily numbers 6000 men. The annual public revenue and expenditure are each about £45,000. The imperial expenditure for military purposes is more than £420,000 per annum. There is an active import and export trade—chiefly a transit one. The harbour, which is formed by the Bay of Gibraltar between the headlands of Cabrita Point and Europa Point, is commodius, and secure from all the more dangerous winds. The greatest width is 5 miles, the greatest length is about 8 miles, and the depth in the centre exceeds 100 fathoms. The shipping is protected by two moles, constructed at great expense, and extending into the bay to the respective distances of 700 and 1100 feet. Gibraltar is a free port, and for many years it was a smuggling centre, where a large manufacture of tobacco and cigars was carried on for the purpose of being conveyed by legions of contrabandistas into Spain.

GIBRAL'TAR, STRAITS OF, anciently called *Fretum Herculeum* (the Straits of Hercules), are about 12 leagues in extent from Cape Spartel to Ceuta Point on the African coast, and from Cape Trafalgar to Europa Point on the coast of Spain. Their width at the western extremity is about 8 leagues, but at the eastern extremity it does not exceed 5. A strong current is constantly running from the Atlantic into the Mediterranean, which renders the passage of sailing-vessels bound to the westward extremely precarious, and only practicable by means of a brisk Levant wind.

GIBSON, JOHN, an eminent sculptor, was born at Conway, in North Wales, in 1790, and is celebrated for his portrait-statues, and for the spirit of poetry which breathes through his many classical works. Born in very humble circumstances he was enabled in his twenty-sixth year to visit Rome, some wealthy friends furnishing him with the means. There he was the pupil of Canova, and afterwards of Thorwaldsen. Nearly the whole of his subsequent life was spent in Rome, where he died in 1866. One innovation that he introduced—that of tinting his figures—called forth much criticism, and his example in this particular has not been followed. Many excellent works were produced by Gibson, and he was undoubtedly one of the best sculptors of his day.

GID'DINESS or **VERTI'GO** is an affection which arises from a variety of causes and assumes several different forms. Sometimes there is merely a feeling of confusion and instability, while at others it seems as if surrounding objects were moving, or as if the patient himself were in motion. Sight is often affected, and objects appear double or run into one another, and hearing is sometimes abnormally sensitive, or there may be a hissing or drumming noise in the ears. It occasionally comes on quite suddenly in persons whose general health appears to be good, while it is an accompaniment of more than one chronic disease. Giddiness is one of the signs of brain disease, but in the vast majority of cases it arises entirely from disordered digestion. It may be brought on by undue haste over a meal, by the use of rich or indigestible articles of food, by too long abstinence, or by the stomach becoming empty. Even when the digestion appears to be in a normal condition attention to the stomach and bowels will often serve to remove the complaint. Nervous exhaustion and depression often give rise to vertigo, and it occurs also from the depressing effects of the immoderate use of tobacco, alcohol, or tea. Overwork, especially when attended with indifferent diet, often brings on attacks of giddiness, generally short in duration, and occurring at intervals of hours or days. The treatment of this form of vertigo consists in the removal of any directly exciting cause, attention to diet, and the use of suitable nervine tonics. Another form of giddiness is that which arises from disease of the ear. It is often called Ménère's disease, from the name of the French physician who first described it, in 1861. This is attended with singing in the ears and partial deafness, and also with vomiting and considerable constitutional disturbance. It is a complaint that calls for skilled medical advice, and requires both general and local treatment. In the former the alkalies and vegetable bitters are generally useful, and a combination of gelseminum and belladonna has been tried with advantage. Giddiness often gives rise to the fear of apoplexy or paralysis, but generally speaking in persons under fifty years of age it is not a complaint that need give rise to much anxiety. It most commonly arises from a disordered state of the liver and stomach, and yields readily to treatment. An attack coming on suddenly and for the first time in the declining period of life, however, should receive careful attention and investigation.

GID'EON, the name of one of the most illustrious of the judges of Israel. He was the youngest son of Joash, of the house of Abiezer and tribe of Manasseh, and lived with his father at Ophrah, a town situated west of Jordan, but of which the exact position is unknown. The early period of his life was spent at a time when the people of Israel were suffering greatly from the incursions of the wandering Midianites, who came up periodically into the land, plundering and destroying both crops and cattle. Idolatrous and disunited, the Israelites were unable to offer any effectual resistance, and were compelled to flee to the mountain strongholds and to the caves of the hills for refuge, or to leave the country altogether. It is very probable that it was at this period that the emigration of Elimelech took place (Ruth i. 1, 2). The story of the call of Gideon to the work of delivering Israel commences Judges vi. 11, where he is introduced as threshing wheat by the winepress to hide it from the Midianites. The narrative is continued throughout the two following chapters, and is too well known to need repetition, but there is abundant evidence that the striking character of the deliverance by the 300 valiant men became one of the most valued of the national traditions. Five hundred years afterwards we find the prophet Isaiah promising his countrymen a deliverance "as in the day of Midian" (Isa. ix. 4). After the victory Gideon appears to have lived in the possession of considerable wealth and influence at Ophrah, but in a private station, having refused to accept the kingship.

over the people. By his numerous wives he left a large family, whose subsequent history was unhappy (see Judges ix. 5). His name is mentioned once in the New Testament, being included in the list of heroes given Heb. xi. 32.

GIES'SEN, a town of Germany, capital of the province of Upper Hesse, in the grand-duchy of Hesse Darmstadt, stands on the banks of the Lahn and Wieseck, about 33 miles N. from Frankfurt on the Main, and has 16,000 inhabitants. The town is old and ill-built, except three or four broad streets. The fortifications have been razed, and their site converted into shrubberies and promenades. The University of Giessen was established in the year 1607. The buildings appropriated to its use are handsome, and contain lecture-rooms, a library, clinical establishment, chemical laboratory, museums of natural history and the arts and sciences, &c. The school of chemistry in this university was rendered famous in consequence of the discoveries of Liebig, whose classes were attended by students from all parts of Western Europe. The town is on the railway from Cassel. It is not a place of much commercial industry, and the manufactures are confined to tobacco, leather, woollen-yarn spinning, stocking-knitting, and cotton-weaving, on a small scale.

GIFFORD, WILLIAM, was born at Ashburton, in Devonshire, in April, 1757. Left penniless at an early age, he was apprenticed to a shoemaker, but from this position he was relieved by a Mr. Cookesley, a surgeon of Ashburton, who conceived a great regard for him, and eventually, by his purse and his influence, caused Gifford to be freed from his indentures, sent to school, and finally, at the age of about twenty-two, to Exeter College, Oxford. Not long after Mr. Cookesley died, but Earl Grosvenor, in consequence of the casual perusal of a letter, became interested in Gifford's character and fortunes, gave him a home under his own roof in or about the year 1782, and in great measure intrusted to him the charge of his son, afterwards Marquis of Westminster, with whom, though widely differing in politics, Gifford maintained through life an intimate and unvarying friendship. Here ends the romantic part of his history. The rest of his life is simply the chronicle of his works. These comprise (besides occasional poems) the "Baviad," a stern and successful satire on the contemptible Della Cruscan style of poetry of the day; the "Mæviad," similarly directed against the absurdities of the modern drama; a translation of Juvenal, prefaced by an admirable little autobiography; and editions of Massinger, Ben Jonson, Ford, and Shirley. In 1798 his ability and peculiar political and anti-Gallican views recommended him to be editor of the *Anti-Jacobin*, and he was afterwards introduced to Pitt, Canning, Lord Liverpool, &c. In 1809 he became the editor of the *Quarterly Review* (founded in opposition to the *Edinburgh Review*). He died 31st December, 1826.

GIFT (Lat. *donum, donatio*), in law, is the transferring of the property in a thing by one man to another voluntarily and without any value in return.

The giver is called the donor, and he to whom the thing is given is called the donee. By the common law real estate might pass as a gift by livery of seisin without deed, but by statute 29 Charles II. c. 3, a deed or note in writing is rendered necessary to the transfer of real estate. To complete a gift of goods and chattels delivery is necessary, for until then the transaction is not properly a gift, but a contract, and the English law will not compel a man to perform his contract unless it is founded on what is called a good or valuable consideration.

Gifts are in some cases declared void, as against creditors and purchasers for a valuable consideration.

In Scotland the law is substantially the same. At common law real estate can only pass by deed duly recorded, this having taken the place of the old sasine. Donation is not presumed.

GIL'DAS, surnamed *Sapiens*, or "The Wise," the most ancient British historian now extant, according to Leland was born in Wales in 511, but according to other accounts in 493. In the middle of the sixth century he was a monk of Bangor, and a spectator of the miseries and ruin of his countrymen. He was probably of Teutonic, not of Cymric race, however, for his reproving remarks on the Cymry are almost too severe for one of themselves to make. At the same time his mournful wail over the barbarism of the heathen conquerors is evidently deeply felt. The desperate nature of the fight which turned England into a heathen country is evident from what Gildas records in his few pages. His epistle or treatise, "De Calamitate, Excidio, et Conquestu Britanniæ," is all that is printed of his writings, and is probably all of them that is extant. The best edition is by Gale, in his "Rerum Anglicarum Scriptores Veteres" (three vols. folio, 1684–87). Gildas died, according to Archbishop Usher, in the year 570.

GILDING, or the process of overlaying surfaces with gold, presents four chief distinctions in the method of operation. These are severally—mechanical gilding, amalgam or water gilding, chemical gilding, and encaustic gilding. The first relates to the application of leaf-gold to wood, or to stucco and other plastic materials used to imitate wood carving. The surface is first prepared with a layer of "thin white," composed of hot size and whiting, followed, if the gilding is to be burnished, by a second coating of "thick white," made of the same ingredients. The whole is carefully rubbed down and smoothed off, and a coating of gold-size is brushed over the surface; which, after being so prepared and dried, is again wetted as the leaf-gold is laid upon it.

In this operation the gold leaves are in succession dropped from the goldbeater's book upon a pad or cushion held in the hand of the workman, and are by a puff of the breath flattened out on this surface and then cut with a knife into the required sizes. Thence the pieces are lifted and laid on the work by a sort of comb formed of delicate bristles, and are pressed close to the wetted surface of the ground by gentle puffs of the breath. When the gilding has reached a certain dryness it is burnished by an agate burnisher. Those portions of the surface that are not burnished are called *matt*, the other parts *burnished* gold.

Oil gilding differs a little from the above in the surface preparation. Two or three coatings of thin white, mixed with a little mellow clay, are applied; then two or three coats of plain gelatine size; and finally, the oil gold-size upon which the leaf is laid.

Amalgam or Water Gilding.—In the gilding of articles of metal pure gold is first combined or amalgamated with quicksilver by boiling the gold in five or six times its weight of quicksilver. The boiling mixture is poured into cold water, by which it loses a great deal of its fluidity, and it is then squeezed through chamois leather. The amalgam has now the consistence of a stiff clay, has a greasy and gritty feel, and is in the most convenient state for being weighed out into the portions requisite for each respective quantity of work. The main object of bringing the amalgam to this consistence and these proportions is to have it in a form convenient for division and apportionment, as well as for the sake of having a uniform standard by which to ascertain the quantity and value of the gold employed.

On the application, however, of this amalgam to the surfaces of metal it is found that, as there is no chemical affinity between the substances thus brought into contact, the direct union of them is impossible. Nor can it be effected by allowing them to remain in contact any length of time. The intervention of a solution of nitrate of mercury is therefore used. This solution is by the operatives termed "quick-water." When a piece of copper or brass is immersed in or brought in contact with this solution, its

surface is immediately converted into an amalgam. To this amalgamated surface mercury and gold amalgam closely adheres, by means of the molecular attraction of the particles of the fluid metals for each other.

The manner in which this agent is applied in practice varies according to the description of articles to be gilt. If they are small, strong, and to be gilt all over, as copper buttons, buckles, and rings, a quantity of them, 3 or 4 lbs. in weight, is put into a deep glazed earthen pan or "jowl;" to these are added about three or four teaspoonfuls of the quick-water, together with the requisite portion of amalgam. The whole is then thoroughly stirred with a brush or stick, till the amalgam entirely covers the surface of every article. When they are completely covered they are by some gilders rinsed in cold water, and dried by shaking in a bag of warm sawdust; while by others this part of the process is postponed to a later period of the operation, and they are put in their wet state, with the generated nitrate of copper still hanging about them, into the cage.

The gilding-cage is made in a cylindrical form, and is generally about 18 inches in length by 9 or 10 in diameter. It is formed of coarse iron-wire gauze, supported by an external framework of iron, furnished with a solid iron door at one extremity. The articles under process of gilding are placed in this cage, and the door of it securely fastened; it is then suspended by its axle on two supports in an iron cylinder. The cylinder being previously heated by a coal fire beneath it to such a degree as to be red-hot over a large proportion of its inferior surface, the cage is introduced and the doors of the cylinder closed. The hinder part of the cylinder is connected with a chamber and flue so constructed as to carry off the deleterious fumes of the mercury.

After the cage with its contents has been in the cylinder for a length of time, varying, according to the temperature at which it has been kept, from five minutes to a quarter of an hour, the mercury will be found to have entirely evaporated from the gilt surfaces. Another application of quick-water and another heating in the cage are sometimes necessary to bring the surface to a proper state. The gilt articles are then heightened, which is generally done by applying a saline solution or kind of varnish, and burning it off by heat.

Buttons and articles of a similar description are often gilt only on their tops, or on some other portion of their surfaces, while the remainder is left uncovered with gold, and of the native colour of the metal of which they are manufactured. This is accomplished by brushing them over the part to be gilt with a hard brush wetted with quick-water, or by rubbing it with a piece of chamois leather similarly moistened. They are afterwards briskly rubbed with a dry brush. They are then put into the gilding-cap, which is a white felt hat of a peculiar sort and shape. The amalgam is put into the gilding-cap along with them. The whole is then well shaken together for a few minutes. The goods are then put into the cage, the mercury is evaporated, and they are afterwards heightened in the manner already described.

For larger goods, and where considerable portions of hidden surface are not required to be gilt, there are two modes of preventing the amalgam from adhering to those portions. One is to lacquer those parts; the other mode of applying the gold is to distribute the quick-water only over the parts requiring it by a small camel's-hair brush, and these then have the amalgam applied as before. If, as is sometimes the case, the goods are to be entirely covered, they are immersed at once in the quick-water. If the articles are of a kind which would be injured by revolving in the cage, the heating is effected by other means. Gilt articles are afterwards coloured to a deeper orange tint by the application of several chemical mixtures, aided by heat.

It is entirely foreign to the present article to make any remarks on the medical effects of mercury on the human frame. Its consequences, as practically experienced by gilders, consist in soreness of the mouth from salivation, nausea and sickness, an oppressive headache, and after the lapse of a few years a paralytic tremor and agitation in all the muscles of the body; nor does any treatment seem to be successful which does not include an entire abstinence from the prosecution of this occupation, and even this is unavailing when "the shakes" have taken possession of their unhappy victim.

Most gilt articles are burnished by a stone burnisher, formed of a polished piece of black hæmatite. This is fixed into a proper handle. Small articles, as buttons, &c., are placed in a lathe, and the stone applied to them as they revolve; and those that do not admit of this are burnished by hand on a table or bench.

Steel and iron are gilt by being immersed in a mixture of the chloride of gold with sulphuric ether or alcohol. An alcoholic solution of gold is formed, from which the metal is precipitated by the iron or steel.

Ivory or bone may be gilt by immersing it first in a solution of sulphate of iron, and afterwards in one of chloride of gold. Silks and satins may be easily gilded by immersing them in a neutral solution of one part of terchloride of gold to four or five of water, and then exposing them to the action of hydrogen gas, which readily combines with the chlorine, and reduces the gold to the metallic state.

The edges of the leaves of books are gilt by applying to them, when squeezed in a press, a composition of four parts armenian bole and one part sugar-candy ground together with the white of eggs. Gold leaf is then laid on, and is afterwards burnished.

For the mode of electro-plating inferior metals with gold see ELECTRO-CHEMISTRY.

Encaustic Gilding.—This distinction relates to the coating with gold of porcelain or glass. The gilding of porcelain is ordinarily accomplished during the process of its manufacture by the application of gold-leaf, which is fixed by that intense heat which confers on porcelain its enamel or glaze, and is afterwards burnished by an agate, as above described. Otherwise the gold is first obtained in a finely divided state by precipitating it from the chloride with ferrous sulphate, or by simply heating the chloride. This powder of gold is ground up with one-twelfth of its weight of oxide of bismuth and some borax and gum dissolved in water, and then painted to the required design on the porcelain or glass ware. Heat vitrifies the borax, and the gold is thereby fixed on the surface to which it has been applied.

Glass may also be gilt by applying leaf-gold to the glass when wetted with a solution of isinglass.

GIL'EAD. See PALESTINE.

GILES, ST., a saint of the Roman Catholic Church, who is said to have been an Athenian of royal descent, and to have devoted himself early to a religious life, settling himself finally in a desert in Provence. One of the traditions respecting him is that the King of France, while hunting in the desert, accidentally wounded the hermit in the knee; and that the hermit, the better to mortify the flesh, refused to be cured, remaining a cripple for life. Hence he is described as the tutelary saint of cripples. The symbol of the saint is a hind, in allusion to the "heaven-directed hind" which came to his cell daily to give him milk. He is sometimes represented as an old man with an arrow in his knee and a hind by his side.

GILFILLAN, GEORGE, a popular divine and brilliant essayist, was born in 1813 at Comrie, in Perthshire, where his father, the well-known Samuel Gilfillan, was pastor of a Secession or Burgher congregation. The writings of the Comrie minister, under the signature of Leumas, in the periodical which was the organ of the denomination

to which he belonged, were read over all Scotland, and were highly prized by members of all the Presbyterian churches. His treatise on the Sabbath went through several editions, and was translated into the French, Dutch, and Russian languages. George, who was the youngest son of his parents, received his early training at the parish school of his native village, and entered the University of Glasgow before he had attained his fourteenth year. He there gained several prizes, and acquired a respectable knowledge of the classics and of mental philosophy, but was mainly distinguished for the extent of his literary attainments. In 1830 he entered the Divinity Hall of the Secession (now the United Presbyterian) Church, and in April, 1835, was licensed to preach the gospel by the Edinburgh Presbytery of that body. He received a call from the congregation to which his father had ministered in Comrie, and another from the School Wynd congregation, Dundee. He preferred the latter, was ordained to its pastoral charge in March, 1836, and continued to officiate there till the end of his life. The first of his numerous works was a small volume entitled "Five Discourses," which was published in 1839, and was followed in 1842 by "Hades, or the Unseen," which was not considered either profound or sound in its theology. It reached, however, a third edition. The young minister's taste for literature drew him away from any absorbing pursuit of theological studies, and in 1845 he published in a separate volume, under the title of "A Gallery of Literary Portraits," a series of sketches, considerably enlarged, which he had contributed to the *Dumfries Herald*, a journal edited by his friend, Thomas Aird, author of the "Devil's Dream" and other poems. This work was remarkably successful, and has passed through a great many editions. A second "Gallery" appeared in 1849, and was scarcely less favourably received than its predecessor. In 1850 Mr. Gilfillan published a work called "The Bards of the Bible," containing sketches of the sacred poetical writers, characterized by fervid, though somewhat inflated eloquence, rather than by critical acumen or spiritual insight. In 1851 he wrote a preface to the "Book of British Poesy," and in the following year he published a work entitled the "Martyrs, Heroes, and Bards of the Scottish Covenant," which Hugh Miller justly pronounced to be Mr. Gilfillan's best performance. A small religious treatise on the "Fatherhood of God" appeared in 1853, a third "Gallery of Literary Portraits" in 1854, and in 1856 his "History of a Man," describing the events of his own life intermingled, not very happily, with fictitious adventures, in which well-known public characters, of whom he knew little or nothing, are represented as taking part with himself. His most elaborate, though not most popular work, entitled "Christianity and our Era," issued from the press in 1857; "Alpha and Omega," two volumes of sermons, were published in 1860; "Night," a poem, and "Remote Stars in the Church Sky" appeared in 1867, "Modern Christian Heroes" in 1869, and "Life of Sir Walter Scott" in 1870. In 1873 Mr. Gilfillan published a "Life of William Anderson, LL.D.," of Glasgow, whom he greatly admired and loved. But the work bears evident marks of hurried preparation, and though it contains a great deal that is exceedingly interesting and well written, it fails to give a correct notion of the subject, for the biographer has painted the portrait of the lion-hearted divine without any shadows. As Goldsmith's art-critic says, "The work would have been better if the author had taken more pains." He edited the "Lives of the British Poets," published by Mr. Nicol of Edinburgh, which extended to forty-eight volumes, and in addition to the numerous works published with his name, he contributed a large number of articles to the *British Quarterly*, the *Eclectic Review*, *Tait's Magazine*, *Hogg's Instructor*, *Titan*, and other periodicals. At the time of his death he was engaged in reading the last proofs of the National edition of the works of the poet Burns, which he had edited, and to which he also contributed an interesting life of the poet, and critique on his writings. Mr. Gilfillan's popularity as a lecturer was almost as great, though not so widely spread, as that which he enjoyed as a literary man, and in both capacities there were few men better known or more generally esteemed in his day than he. He was an earnest, impressive, and fervid preacher, and discharged the duties of a Christian minister with praiseworthy diligence and fidelity. Referring to the connection of these duties with literary pursuits, he says in his "History of a Man," "In my own humble way I have sincerely and conscientiously sought to unite and harmonize literature and the duties of a clergyman; and however imperfectly I may have succeeded I do not regret the attempt, since I believe it has in some instances made my voice be heard with greater deference first when I spoke to Christians of the glories of genius and the charms of literature, and far more when I spoke to young lovers of literature of the superior claims and infinitely higher merits of the Book of God."

In private life Mr. Gilfillan was amiable, warm-hearted, and obliging, and was much liked by a wide circle of friends, who greatly lamented his loss while still in full possession of both intellectual and physical energy and activity. He died somewhat suddenly on 13th August, 1878.

GILLE'NIA, a genus of plants belonging to the order ROSACEÆ, and nearly allied to Spirea. *Gillenia trifoliata* has several stems, a foot or two in height, from the same root. It is a native of North America, in shady places, from Florida to Canada. The root is emetic, and possesses properties similar to those of ipecacuanha. *Gillenia stipulacea* grows in humid woods and damp places from Tennessee to Kentucky, in North America. The medicinal properties of this species are the same as those of *Gillenia trifoliata*. The species of Gillenia are elegant and hardy plants, and are therefore worthy of cultivation.

GIL'LIFLOWER is a corruption of the *gylófre* of Chaucer. There is no doubt that in his time the name was given to small varieties of the carnation (*Dianthus Caryophyllus*). The English word came through the French *giroflée*, Italian *garofalo*, from the Low Latin *gariofilum*, itself a corruption of *caryophyllum*, a clove. The carnation or clove pink seems to have been used to flavour wine instead of the costly spice of the East Indies. Parkinson ("Parad." p. 306) says:—"I account those that are called carnations to be the greatest both for leafe and flower, and gilloflowers for the most part to bee lesser in both." Shakspeare also makes a distinction between the two—

> "The fairest flowers of the season
> Are our carnations and streaked gillflowers."
> —"*Winter's Tale*," Act iv. sc. 3.

The name has been transferred to some of the Cruciferæ; for instance, *Matthiola incana* is the stock gilliflower, that is, the gilliflower which grows on a stem or stock, to distinguish it from the true gilliflower. Again, *Cheiranthus Cheiri*, a plant introduced from Spain, was originally called the wall stock-gillofer, which became afterwards wall-gilliflower, and finally wall-flower. *Hesperis matronalis* is dame's, or queen's, or rogue's gilliflower; and a double variety of this is called Whitsun gilliflower. Other orders also contribute gilliflowers—*Lychnis Flos-cuculi* is cuckoo or marsh gilliflower; *Armeria maritima* is the sea gilliflower; *Hottonia palustris* is the water gilliflower. (See "English Plant Names," by Britten and Holland.)

GILLRAY, JAMES, the celebrated caricaturist, was born about the middle of the last century. He was originally a writing engraver, and is said also to have been a strolling player for a short time. He had an acute perception of character, a strong sense of the ludicrous, and at the same time a great ability for drawing, with a prac-

tical skill in engraving. His great faculty was the burlesque; his chief subjects political and social abuses. An "Illustrative Description," with a complete set of his genuine works in 804 sheets, was published by M'Lean, London. Gillray died insane on the 1st of June, 1815. His works, with the "Story of his Life and Times," were published in 1874.

GILLS (Lat. *branchiæ*), the name given to the organs of respiration possessed by animals breathing air dissolved in water. The business of respiration, which is essentially the giving off of carbonic acid and the absorption from the surrounding medium of oxygen, is carried on in the lowest sections of the animal kingdom by the whole surface of the body. In higher groups the function becomes localized and gills are formed. In the Crustacea the gills are differentiated from the appendages. In the Mollusca the gills are always differentiations of the integument. In the Vertebrata gills are possessed as the sole organs of respiration by fishes, and together with lungs by the Amphibia. The gills of vertebrates are typically lodged in a cavity, but they may come to the surface as external filaments. External gills are always present in the Amphibia in the embryonic condition, and in some of this class (Perennibranchiata) persist throughout life; in the rest of the Amphibia (Caducibranchiata) the external gills soon disappear. See RESPIRATION, FISHES.

GILPIN, BERNARD, was born in 1517 in Westmorland. Having resigned a small living in the county of Durham and exiled himself from England during the early part of the reign of Queen Mary, he ventured to return before her death, and was cordially received by his relative, the estimable Cuthbert Tunstall, bishop of Durham, who made Gilpin archdeacon of Durham and rector of Houghton-le-Spring. His bold preaching for ecclesiastical reform led to his citation before Bonner, bishop of London. "Give me," said Gilpin to his house-steward as he set out, "a long garment, that I may die with decency." An accident, however, delayed him on the road; Queen Mary died, the system was changed, and Gilpin returned in joy and peace to Houghton, of which place he continued rector until his death in 1583, although the bishopric of Carlisle was offered to him by Queen Elizabeth. Gilpin was the very exemplar of a true Christian pastor. He went fearlessly forth into the debatable land of the Marches in Northumberland, among the lawless people that occupied it, and did much to change the character of the country. He was called indeed the Northern Apostle. At home he made the wealth of his rectory a blessing to all who were within his influence. All travellers were welcome, and seldom was his hospitality abused. Another of his titles was the Father of the Poor, which explains sufficiently its own origin. We need only add he was a zealous educationist.

GILT'HEAD (*Chrysophrys aurata*) is a species of fish belonging to the sea-bream family (Sparidæ). The generic characters are as follows:—Body deep, compressed; dorsal fin single, the rays partly spinous, the posterior rays flexible; teeth of two kinds, six canines in each jaw, conical, with rounded and oval molar teeth, in four rows above and three below; cheeks and operculum covered with scales; branchiostegal rays six. The gilthead is common in the Mediterranean, and is occasionally found as far north as the British coasts. It is the Aurata of the Romans, who kept it in their fish-ponds (*vivaria*). A noted epicure, Sergius Orata, is said to have derived his surname from this fish. The most esteemed giltheads, according to Martial, were those which had fed upon the shellfish of the Lucrine Lake. The name given it by the Greeks ("with golden eyebrows") alludes to the golden spot it bears over each eye. The gilthead feeds on molluscs, the shells of which it breaks with its strong teeth. Several other species of the genus Chrysophrys are known, chiefly from tropical seas.

GIN or **GENEVA,** an aromatized spirituous beverage extensively consumed in Holland and in the large towns of England. Both names are derived from the French *genièvre* (juniper), the characteristic flavour of the spirit being properly derived from juniper berries. Immense quantities of this spirit are distilled at the town of Schiedam in Holland, and it is often called after the names of both town and country *Schiedam* or *Hollands*. In the Dutch manufacture the mash used to produce the spirit is composed of malt and rye meal, and the wash formed by its infusion and fermentation is distilled with the addition of juniper berries and a little salt, and occasionally with the addition of hops. In the English manufacture plain grain spirit obtained from the whisky distilleries is distilled and rectified with various flavouring ingredients in addition to or in the place of the juniper berries—corianders, cardamoms, cassia, cinnamon, crushed almond cake, oil of turpentine, and other essential oils being used for this purpose. A common quality is said to be made by distilling a mixture of spirit of turpentine, salt, and water with plain proof spirit, and afterwards sweetening the liquor obtained with sugar. From its comparative cheapness gin is more largely consumed by the intemperate among the lower classes of English towns than any other spirit, and there is perhaps no article of sale that is more frequently adulterated. Of the ingredients used in adulteration some, like cayenne pepper and sugar, which are used to conceal the weakness caused by diluting the spirit with water, are comparatively harmless, but there are others which are of the most deleterious character. Gin is frequently prescribed in diseases of the urinary organs, the oil of juniper being a very powerful diuretic; but no beneficial effect can be expected from the adulterated spirit so often sold under the name. The principal distilleries of gin in England are in London, Plymouth, and Bristol.

GIN or **GYN,** a machine employed instead of a crane. It consists of three round poles placed up in a pyramidal form, within which a windlass and tackle afford the means of raising weights. When the machine is to be used it is set up over the object to be raised. Gin is also the name of the machine for cleansing cotton.

GIN'GALS or **GIN'GAULS,** large muskets used in India by some of the natives, generally with a rest and matchlock; but they are very cumbersome when compared with the modern rifle, and are gradually being superseded by that weapon.

GIN'GER is the underground stem (rhizome) of *Zingiber officinale*. The rhizome throws up barren leafy reed-like stems 3 or 4 feet high, and occasionally flowering stems. The flowers are arranged in a cone-shaped spike, each in the axil of a large greenish-yellow bract. The corolla is orange-yellow, divided into three long segments. One of the staminodes forms a large purple three-lobed lip. Ginger is probably a native of tropical Asia, but is now cultivated in all warm countries. The name occurs in a list of imports into Alexandria in the second century, and during the middle ages was evidently an important article of commerce. It is often mentioned in the Old English leech-books of the eleventh century; and during the thirteenth and fourteenth centuries it was the commonest spice, next to pepper, though 1 lb. of it cost as much as a sheep, about 1s. 7d. (Rogers, "History of Agriculture and Prices in England").

The rhizomes are dug up, when about a year old, and dried in the sun. Sometimes the skin is scraped off before drying, and this is known in commerce as *scraped*, *uncoated*, or *white ginger*; the other kind is sold as *coated ginger*. The principal constituents of ginger are starch, a volatile oil which gives it the peculiar odour, and a resin to which is due the burning taste. Ginger has stimulating, aromatic, and carminative properties, which render it of value in atonic dyspepsia, and in purgatives to correct griping. When chewed it is useful in relaxed conditions

of the uvula and tonsils. It is, however, more largely used as a condiment than as a drug. The young rhizomes are imported in jars, preserved in syrup.

GINGER-BEER, a summer drink much used in England, especially in the country districts. It is made by fermentation, the liquid being bottled before the process is complete. It is made in various ways, but perhaps the most common and useful is to mix in a vessel 5 lbs. of lump sugar, 5 ounces of ginger, 4 ounces of cream of tartar, ten sliced lemons, 10 ounces of yeast, and 5 gallons of boiling water. This should be kept in a warm place and allowed to ferment for twelve or twenty hours, then strained, skimmed, and bottled, with the corks well tied down. In a few days it is ready for use.

GINGER-WINE is a cheap and popular drink made by the fermentation of sugar and water, and flavoured with ginger. It is requisite to use the very best materials and to exercise the greatest care in the manufacture of this article. Spirits are usually added in small quantities to make the wine keep, to increase its strength, and also to modify its flavour.

GIN'GERBREAD, a kind of bread that has been popular in England for five hundred years. It was originally made by kneading up rye flour with honey, ginger, and other spices; but treacle soon took the place of honey, and it was made with other flour than that of rye. Cakes of gingerbread having one side gilded formed a popular article of sale at the fairs of the country and the metropolis for a very long period, but gilt gingerbread is but rarely seen at the present day. Modern gingerbread is made of wheat flour, treacle, moist sugar, ground ginger, and butter, and it is made up in the form of cakes, biscuits, or nuts. There are several different recipes in use, and in large towns there are generally one or two makers who have a reputation for its manufacture.

GING'HAM, an Indian name for a cotton fabric originally made in India, but now manufactured almost exclusively in Britain. The difference between calico and gingham is that in the latter the colours are woven in, and not afterwards printed. Umbrella gingham is, however, woven with yarn of one colour. (The first *g* in gingham is hard.)

GINK'ELL or **GINCKELL, GODART VAN,** first Earl of Athlone, was a native of Holland, and the head of a family of great antiquity in that country, where he bore the title of Baron van Reede, &c., and was a general of cavalry. He came to England at the time of the Revolution in 1688, and when two Scotch regiments in March, 1689, declared for King James, and marched from Abingdon for Scotland, General Ginkell was sent after them with a body of horse, and soon overtook and dispersed them. He commanded a party of Dutch horse at the battle of the Boyne, 1st July, 1690. When King William returned to England the conduct of the war was left in the hands of Ginkell. The town of Baltimore surrendered to him, 7th June, 1691; Athlone was taken by storm, 1st July; he gained the battle of Aughrim, 12th July; and put an end to the war by the capture of Limerick, 3rd October. On the 4th of January, 1692, the Commons ordered seven of their members to take to him the thanks of the House, and on the 20th of February he was made a peer of Ireland, with the titles of Earl of Athlone and Baron of Aughrim. The earl subsequently returned to Holland, but continued in the service of King William, shared in his defeat at Landen, 29th July, 1693, commanded the Dutch horse in Flanders in 1695 and 1696, and the Dutch forces generally under Marlborough in the war with France during the reign of Queen Anne. He died on the 10th of February, 1703. The title became extinct in 1844. (The *g* in Ginkell is hard.)

GINK'GO is a genus of Conifers containing only one species, *Ginkgo biloba*, the Ginkgo tree of Japan and China. It is also known as *Salisburia adiantifolia*, the generic name being given in honour of the botanist Salisbury; but Bentham and Hooker have restored the original name of Kæmpfer, who had adopted the Japanese name of the tree for his genus. The leaves are suggestive rather of those of a maiden-hair fern than of a conifer. The flowers and fruit show it to be allied to the yew, and to belong to the tribe Taxeæ. See CONIFERÆ.

The male and female flowers grow on distinct trees, and though both kinds of trees are cultivated in this country, only the male flowers blossom. In the south of France the fruit ripens, and young plants have been raised from the seed. The male flower consists of a single stamen with two pendulous anther-cells; they are borne, several together, in slender catkins without bracts. Each female flower consists of an ovule seated in a cup-shaped stalked scale (lamina). The seed is drupaceous. The tree attains a height of 60 or 80 feet in its native country. It was introduced into England in 1754. It grows rapidly, attaining a height of 10 feet in ten years and 50 feet in fifty years.

GIN'SENG, a root found in China to which extraordinary properties have been ascribed. It is not only considered a universal remedy for all maladies, but is spoken of in the highest terms as a specific in particular circumstances. Lockhart (medical missionary in China) states that all the ginseng grown in China is imperial property, and is sold for its weight in gold to those privileged to retail it. It grows chiefly in the mountains surrounding the Ussuri district, whence it has spread to Mantchuria and Corea. The best kind grows in Corea; that cultivated in Japan is not considered to have such active properties. Ginseng is prepared by boiling the roots down until the juice is so thickened as to become hard. The plant (*Aralia Ginseng*) belongs to the ivy order, ARALIACEÆ; a species of the same genus very much like it, namely *Aralia quinquefolium*, grows in North America, and has been imported into China as a substitute, but has failed to win popular favour. Ginseng has been tested in Europe, and no valuable properties have been found in the root.

GIORDA'NO, LUCA, an eminent painter, was born at Naples in 1632, and died there in 1704 or 1705. His fine imagination was accompanied by extreme rapidity of execution. The number of his works is very large. His by-name, Fa-presto (*Luca, fa presto*, Luca, make haste), perpetuates the memory of his father's avarice, who was always urging him on, even at meals, the ready cause of a nickname among Luca's companions. In 1679 he was invited by Charles II. of Spain to adorn the Escurial. He returned to his own country after that monarch's death. His best works are his frescos in the Escurial at Madrid, at Florence, and at Rome. Some of his finest pictures are at Dresden. The grand altar-piece in the Church of the Ascension at Naples, representing the "Battle of the Angels and the Fall of Lucifer," is by Giordano.

GIORGIO'NE. *Giorgio Barbarelli*, called Giorgion (great George), one of the most distinguished artists of the Venetian school, was born in 1477 at Castelfranco, in the Trevisano. He received his education at Venice, where he at first devoted himself to music, and became an excellent performer on the lute. He, however, soon deserted this for painting, and became the disciple of Giovanni Bellini, but quickly adopted a much freer style. Titian, one of his fellow-students, is said to have been so struck at a later period with Giorgione's style and colouring as to have become his pupil; they were intimate, at all events, until Giorgione's jealousy was aroused. The greatest works of this artist were in fresco, but very little remains of them. The "Finding of Moses," in the archiepiscopal palace of Milan, and "Christ bearing the Cross," at Venice, have been looked upon as his masterpieces. Giorgione is the most unlucky of all the great mediæval masters.

His works remaining to us may almost be counted on the hand; they quite bear out, however, the great reputation he attained for a certain luminous glow and depth of colour which he was the first to acquire. In this he is excelled by Titian alone. He died at Venice, during the plague in 1511, at the age of thirty-three years.

GIOT'TO (properly *Ambrogiotto Bondone*), born in 1266 at Vespignano, a village not far from Florence, was the son of a peasant. There is a pretty but quite baseless old legend, long believed, that while tending sheep in the fields he was found by Cimabue drawing a sheep on a piece of slate, and the artist was so struck with the performance that he asked Giotto's father to intrust his son to him, took him to Florence, and instructed him in painting (in distemper or fresco, oil painting not being then discovered). Giotto soon excelled his master. He first freed art from the dry and hard manner which then prevailed, and gave expression and action, dignity and grace to his figures. In this last quality he remained unequalled till the appearance of Masaccio. His reputation spread throughout Italy, many cities of which are adorned with his works. He may also be called the restorer of portrait painting, and has, together with the features, given us the air and character of Dante, who mentions him in his poems. He was a man of high genius and knowledge, pleasant in conversation, and fond of poetry. He went with Pope Clement V. to France, where he executed many fresco paintings. Giotto was one of the architects of the splendid cathedral at Florence. Much of the beautiful marble ornamentation is from his designs. But his chief glory, even excelling his fame as a painter, is the quite unrivalled campanile (belfry tower) with which he ornamented the cathedral. It may probably be confidently asserted that this is the most beautiful building of its kind in existence. [See CAMPANILE, article and Plate.] Giotto died in 1337.

GIOVAN'NI, DON (or more strictly, *Don Juan*, for the home of the monster is always placed in Spain), is the hero of a world myth as universal as that of Faustus himself among modern Europeans. Don Juan is the type of an irresistible libertine. No woman can resist him, nor does he even attempt to master his own desire of conquest. He is the mere male animal, devoid of conscience, utterly selfish and cruel, caring only to satisfy his appetite, no matter at what cost. Unhappily, however, Mozart has dignified this filthy legend with some of the sublimest music of the Italian operatic stage, and until Byron's time Don Giovanni threatened as a title to absorb Don Juan altogether. With equally disastrous consequences Byron cast the glamour of his verse over this ugly subject, and alternated passages of beauty and tenderness with mirth-provoking rhymes and barbed sarcasms, so that no lover of literature can altogether withhold himself from the alluring banquet spread before him by the poet. "Don Juan" is certainly Byron's greatest work. In his case the selection of the subject was one last supreme defiance flung in the face of the pruriently prudish society which had so ill-treated him. We have stigmatized the legend as filthy, and that is indeed the epithet it deserves when all the graceful and romantic additions of art are stripped away. It is needless to say that in the hands of Mozart, of De Musset, and even, one might almost say, of Byron, the grossness of the idea is veiled and all the brighter sides of it carefully brought out. Still, to hear the one or to read the others must always make the judicious grieve. Thanks to ignorance of Italian the modest girl who warbles a part in "La ci darem" is innocent of the shock she often causes her better-read father. Happily such a legend could not in these days form the theme of poet or of composer; those times are for ever past.

The subject of Mozart's opera is the most favourite part of the legend, the close of the libertine's career. He is pursuing a young lady of rank, daughter of the governor of Seville, and as her screams bring her father to her aid, he makes no scruple of killing him. One of Juan's many deserted mistresses, whom indeed he had long ago married with a mock ceremony in order to obtain her, offers to assist the orphan to discover the murderer and seducer, and the lover of the heroine is of course eager to join in avenging his beloved. These three track Don Juan, and discover him already at work against the peace of a village girl at a country festival. Escaping, he passes by the statue of the governor, and is miraculously addressed by it. In reply he invites the statue to supper in his own tomb with many insults. At supper, however, to his horror the statue descends into the vault, takes him by the hand, and drags him down to everlasting torment. The time of the legend is fixed under Peter the Cruel, and the hero is said to have been of the famous Tenorio family. Probably there is about as much basis of truth as for the legends of Arthur, of Roland, and of Faustus. The earliest treatment of this part of the legend is that of Tirso de Molina in Spanish ("El Burlador de Sevilla"). This was shortly afterwards produced in Italy (1620). Molière introduced it into France ("Le Festin de Pierre," 1669), and Shadwell into England ("The Libertine," 1676). In 1690 Zamora's more famous Spanish version, rewritten from that of Molina, appeared, and Mozart's opera follows this with but few alterations ("Don Giovanni," 1787). As a sample of the story opera-goers will remember the song of Leporello, Don Giovanni's servant, recounting his master's conquests, and enumerating in humorous exaggeration 640 mistresses in Italy, 231 in Germany, 91 in Turkey, 100 in France, but 1003 in Spain *already* ("ma in Ispagna son' gia mille e tre"). Ten years before Mozart, Vincenzo Righini had set it as "Il Convitato di Pietra" ("The Marble Guest," 1777). Byron's "Don Juan" is original; the idea alone, not the incidents of the legend, is taken—the poet carries his reader through a succession of love-scenes occurring in most of the countries of the world. The poem was never finished, it breaks off in the middle of an English escapade. So also De Musset's wonderful fragment, "Une Matinée de Don Juan," hitting off the soul of the myth in a few lines of exquisitely polished French dialogue (between Don Juan and his servant), Mérimée's novel, "Les Ames du Purgatoire, ou les Deux Don Juan," and Dumas' drama, "Don Juan de Maranna," follow the spirit, not the letter of the legend. Probably mere licentiousness is now beyond the power of art to use as its model; at least some nobler elements must be introduced. Introduce such elements, however, and you no longer have the true Don Giovanni.

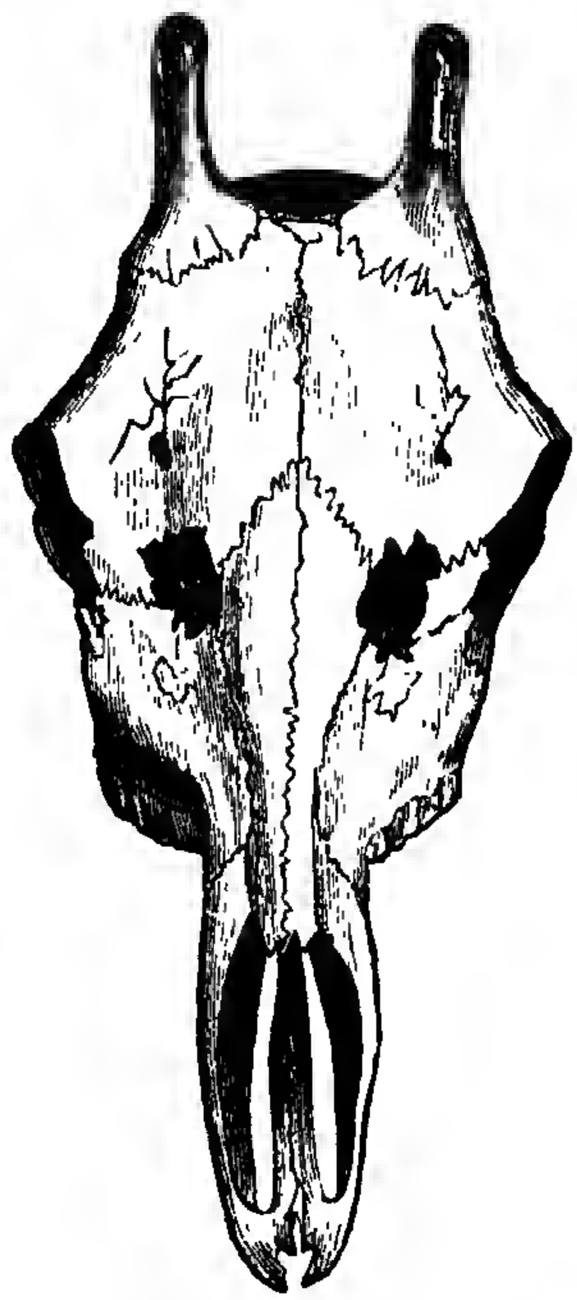
GIPSIES. See GYPSIES.

GIRAFFE or **CAMELOPARD** (*Camelopardalis giraffa*), an animal belonging to the RUMINANT division of the artiodactyle (even-toed) Ungulata. This species constitutes a distinct family, Camelopardalidæ, intermediate between the deer family (Cervidæ) and the hollow-horned ruminants, the oxen and antelopes.

The giraffe, measured from the fore hoofs to the top of the head, stands the tallest of all known quadrupeds, the males measuring usually from 15 to 16 feet, but sometimes attaining a height of 18 feet; the females are somewhat smaller. Its skeleton is a very striking object. The small light head lifted on high upon an extremely elongated neck, the high withers, and the slender length of limb, taken together, contrast strangely with the bony fabrics of other quadrupeds; yet this long neck consists only of seven vertebræ, the normal number in mammalia. The so-called horns are processes of bone covered with skin, having a tuft or coronet of black hairs at the top; they exist both in the male and female, but are far more developed in the former. The horn-like peduncles continue for a long time united to the skull only by means of suture, and are not fairly ankylosed till an advanced period.

A third median process is prominent in the male, and is often called a horn; this, however, has been shown to be merely a thickening of the frontal bone, not a process articulated by suture. Another peculiarity in the skull arises out of a remarkable extension of the frontal, ethmoidal, and sphenoidal cells (see cut below). These form a series of large intercommunicating air cavities on the top of the head, reaching from the middle of the head to the occiput.

With regard to the dentition, stomach, and digestive organs the giraffe agrees generally with the ruminants. The gall-bladder is usually absent. The kidneys are not lobulated, as in the ox, but simple, as in the deer and antelopes. The structure of the tongue of the giraffe is very remarkable; it is at once an organ of taste, of touch, and



Front View of the Skull of the Giraffe.

of prehension. It is capable of the most extraordinary elongation, and is flexible to the utmost possible degree. The tongue is long, slender, and pointed, and is much used in the acquisition of food, as the animal coils it round the twigs and foliage of trees, which are drawn by its means between the lips. It is in fact very interesting to see with what address the giraffe uses this instrument, and how dexterously he applies it as a hook or holder; indeed, the power of prehension and the sense of touch are so developed that the animal can grasp with the extended tongue an ordinary lump of sugar and convey it to the mouth. This organ is very smooth, except when the papillæ are raised; it then becomes rougher, and slightly adhesive. It is spotted, but the spots are not raised. The lips are muscular, prominent, hair-clad, and extremely flexible; they aid the tongue in its various offices. The ears are large, long, pointed, and movable, and the sense of hearing is very acute. The eyes are full, large, dark, lustrous, and prominent, and the upper eyelid is fringed with long lashes; so prominent indeed are the eyes, that without turning its elevated head the animal can command a survey of the whole horizon, and mark the approach of an enemy from any quarter. Hence the difficulty of stealing upon the giraffe unawares, and the accuracy with which, when run down, it defends itself by a rapid storm of kicks against its aggressor. There are no suborbital sinuses. The nostrils are narrow, and are provided with cutaneous sphincter muscles, for the purpose of closing them at pleasure. The object of this mechanism is to keep out the sand when the storms of the desert arise. The hoofs are simply divided, and the lateral supplemental or rudimentary toes so often occurring in ruminants are wanting.

Along the back of the neck runs a short stiff mane; the tail is moderately long, rather slender, and tufted at the extremity with coarse black hair. The fore knees are large, and furnished with slight callosities, as is also the chest. The elevation of the withers is remarkable, and from this part to the crupper there is a rapid descent, whence has arisen the idea that the fore limbs, from the body to the ground, are much longer than the hinder pair; but this is not the case. When about to lie down the animal first sinks upon the fore knees, and assumes an attitude apparently very constrained, and certainly not graceful. In walking the movements of the giraffe are

Head of Giraffe, with the tongue elongated.

strange and peculiar. It does not then carry its beautiful swan-like neck erect, but obliquely forwards in a line continued from the spine over the withers to the top of the head; while, owing to the shortness of the body and the length of the limbs, the hind hoofs are brought at each step as far forwards as the spot previously occupied by the fore hoofs, but somewhat to the outside, for the hind limbs diverge to a certain degree outwardly from the hock-joint. The legs on each side are in action nearly in unison together, those on the right side appearing to alternate with those of the left, and *vice versâ*. The giraffe, however, is not really awkward, and is very far from being slow; the swiftest coursers of the desert are scarcely equal to the chase, and over rugged and broken ground utterly unable to overtake it. The Hottentots are fond of the marrow; and of the skin they make vessels in which they keep water and other liquors. They kill the giraffe with poisoned arrows.

The giraffe is confined to Africa, south of the Sahara, extending from Nubia and Abyssinia down to Cape Colony. It is gregarious, living in small troops, preferring open ground. It feeds on the foliage of trees, especially mimosa twigs and blossoms. It is naturally gentle, timid, and docile, but when brought to bay it will face the foe, be it man or lion, and defend itself vigorously with its heels. The hide of the giraffe is whitish, mottled throughout with angular tawny spots. The giraffe, except in the rutting season, is mute.

Well known as the giraffe is in the present day, from the living specimens which have from time to time been imported into England and France, and from the skeletons and preserved specimens which adorn the large museums of Europe, so little was known respecting it a few centuries ago that the most incorrect ideas were entertained respecting it. The ancient Egyptians were well acquainted with the giraffe. The celebrated Prænestine pavement, said to have been made by the direction of Sulla, who held the office of quæstor in Numidia, represents the giraffe both grazing and browsing; and it seems to be a probable opinion that the artists employed to work in mosaic, even in Italy and Spain, were Egyptian Greeks. Still the animal does not itself appear to have been seen in Italy before the time of Julius Cæsar, who exhibited it among other animals in the Circensian games. In subsequent periods the giraffe was not unfrequently brought to Rome, and the third Gordian had ten at one time. We trace the animal in the writings of Artemidorus, Strabo, Appian, Heliodorus, and others, till at length we lose it in the darkness of the middle ages. After the revival of letters the giraffe again appeared in Europe. This individual was in the possession of Frederick II., emperor of Germany (crowned 1215), and was sent as a present from the Prince of Damascus. Towards the end of the fifteenth century the Soldan of Egypt presented one of these animals to Lorenzo de' Medici, grand-duke of Tuscany; it was a great favourite with the inhabitants of Florence, and was accustomed to walk about the streets, stretching its neck to the balconies and windows for fruits and other articles of food. From this time no living giraffe was seen in Europe for nearly three centuries and a half, though in that space various descriptions and figures were published by writers on natural history, mixed up with abundant errors.

Sparrman, during his travels in South Africa from the year 1772 to 1776, became acquainted with the giraffe, and gives some interesting information respecting it. He notices that, when feeding upon grass, it sometimes bends one of its knees as horses do, and that in plucking leaves from high trees it brings its fore feet about 1½ foot nearer than usual to the hind feet.

Le Vaillant did not meet with the giraffe till his second journey into the interior of Africa from the Cape, during the years 1783–85. His description of the habits of the animal and his narrative of the incidents of the chase are interesting and graphic, though perhaps a little overcoloured. From this time we may date our more correct knowledge of this animal, of which several skins found their way from time to time into our island. It was in the year 1827 that the first living giraffe was brought to England. It was sent to George IV. by Mohammed Ali, the viceroy of Egypt. It lived, however, for a few months only in the menagerie at Windsor. In 1836 the arrival at the gardens of the Zoological Society of four living giraffes, procured in Kordofan by M. Thibaut, created a lively sensation in the scientific world. One of these, the only female, gave birth to no less than seven fawns before her death in 1852. At present there are four giraffes, two males and two females, in the society's collection.

The giraffe, with due care, endures our climate much better than might have been anticipated, and breeds even under some degree of restraint. The period of gestation is about sixteen months. In confinement the giraffe eats hay, carrots, and is partial to onions.

Fossil species of giraffes have been discovered in miocene deposits in Greece and in the Siwalik Hills in India. Hellodotherium, an allied genus, occurs in the same deposits in the south of France.

GIRAL'DUS CAMBREN'SIS (Gerald of Cambria, *i.e.* of Wales) is the name by which *Gerald du Barri* is usually known. He was born in 1147, and died in 1216. He is among the most interesting and reliable of the chroniclers of our Norman kings, giving us our best account of Henry II., of Richard the Lion-heart, and of John. Gerald du Barri was by his mother's side and by his birthplace a Welshman, born near Pembroke, and trained to the church partly by his uncle, the Bishop of St. David's, partly at Paris. Gerald's father was a Norman, and helped Strongbow in the conquest of Ireland. Henry II. therefore sent him with Prince John on the Irish expedition of the latter, partly to help by his Irish connections, partly also to take him away from St. David's, where he had been elected bishop, for he was far too strong a man and too ardent a Welshman to fall in with the king's policy of unity and submission. This journey enabled Gerald to write the valuable "Topography of Ireland" (1185), and the immediately succeeding "History of the Conquest of Ireland" (1186). His work is in Latin, and it is with a smile that one recognizes in the hero *Stephanides* a classical transformation of plain *Fitz Stephen*, or that one finds the tale of an assault prefaced by almost as long and pointed orations (and equally void of authenticity) as those in Thucydides. But though the epic vein is a little laughably predominant, the work itself is beyond cavil in its extreme value. It is most careful and accurate, almost unequalled, indeed, in these respects among our early records. In 1188 an invitation to accompany the Archbishop of Canterbury in a mission through Wales preaching the crusade enabled Gerald to accumulate materials for the "Itinerary of Wales." He returned to stand by the bedside of his dying patron, Henry II. (1189). John, regent during King Richard's absence in the Holy Land, offered Gerald the see of Bangor, which, however, he declined. As he expected, the Bishop of St. David's died, and the clergy shortly afterwards, for the second time, elected him bishop. Again his king refused, and this time the archbishop also interfered. Gerald had designs for the independence of the Welsh Church, and moved by his great patriotism he even braved the dangers of a journey to Rome across a Europe blazing with war. He spoke before Innocent III. in 1199, but the pope evaded his claims—he, too, having designs upon England of a far other nature. After a weary controversy Gerald du Barri gave up the hopeless conflict, returned home, made his peace with John, now king, and was received into favour—even enjoying substantial pecuniary solace at the king's hands. He wrote many other books, especially one on church matters, "Gemma Ecclesiastica," and one in autobiographical style, "De Rebus a se gestis."

The style of Giraldus Cambrensis is peculiarly bold. The historian Green (in his "History of the English People," 1876), says of his pamphlets that they are just the sort of lively dashing letters that we find in the correspondence of a modern journal; his profusion of jests, his fund of anecdote, the aptness of his quotations, his natural shrewdness, and the vivacity of his style are backed by a fearlessness and an impetuosity which made him a dangerous assailant even to such a born ruler as Henry II. Half the scandal about Henry and his sons is due to the bitter pleasantry of this Welshman, eager to free his country, if he dared, from those whose servant he was bound to be.

A very fine and complete edition of Giraldus Cambrensis has been recently completed under the direction of the master of the rolls. The work was begun in 1861, and the six principal volumes were finished by 1875.

GIR'ASOL, called by the ancients *Asteria*, is a precious stone of great value and beauty. It is found of various colours, such as emerald green and yellow, but generally bluish-white. The best specimens come from Brazil; it has also been brought from Siberia. Its peculiarity consists of the beautiful reflection of bright red and yellow it exhibits when exposed to a strong light, and which seems to come from the interior of the stone. The name is sometimes incorrectly applied to fire-opal, asteria

sapphire, and sunstone, on account of the similar reflection which they show.

GIRDERS. The timber or iron beams employed in building operations to carry loads over large openings are known technically by the name of girders. They are much used in supporting the upper walls of houses while the lower part is cut away to allow of rearrangement, and also in railway works, when they are generally made of wrought iron.

GIRDLE (from the Anglo-Saxon *gyrdel* or *gyrdl*, and that from *gyrdan*, to encircle or bind around), a band of leather, or some other substance, to gird up the loins. The term girdle was in former times very frequently used to express the purse, apparently because it was adapted to contain money; and as the sword was suspended from it the expression "to turn the girdle" was used to signify preparation for fight. The girdle was generally worn in England, and the making of girdles was a trade. Among the ancient companies of London that of the girdlers was incorporated as early as 6th August, 1448, 27 Henry VI.

GIRGEN'TI, the chief town of a province of the same name in Sicily, is built on the slope of a hill, about 2½ miles from the coast, and about one mile from the ruins of old AGRIGENTUM. The town is irregularly built; it is a bishop's see and has about 20,000 inhabitants. The cathedral and the monastery of San Nicolo are the principal buildings. The cathedral, a large, heavy building of the thirteenth century, is in the Norman style, barbarously mixed with a modern imitation of the Greek orders: its chief curiosity is an echo, or *porta voce*, by which a whisper is conducted from the entrance to the cornice over the high altar (280 feet). It has a beautiful font of carved stone, and some pictures, one of which is a Madonna by Guido. Bishop Lucchesi, a great benefactor to Girgenti, among other acts of enlightened policy, founded a seminary for the clergy, and a good public library, to which he bequeathed a valuable collection of antique vases, coins, and medals. There are also a great many other churches and convents. On the coast are a port, with a mole, two lighthouses, corn magazine, prison, &c. The extensive remains of the ancient city, east of the modern town, comprise the magnificent temple of Concord, the remains of a vast temple of the Olympic Jupiter, the tomb of Theron, and portions of temples of Juno, Hercules, Vulcan, and Castor and Pollux. Girgenti is the chief port in Sicily for the shipment of sulphur. The other principal exports are corn, almonds, sumach oil, and soda.

GIRONDE, the name given to the estuary of the Garonne and the Dordogne. See GARONNE.

GIRONDE, the largest department of France, formed out of the most western part of Guienne, is bounded N. by the department of Charente-Inférieure; E. by that of Dordogne; S.E. by that of Lot-et-Garonne; S. by Landes; and W. by the Bay of Biscay. The form of the department is very irregular, except along the coast, which runs in nearly a direct line N. and S. for 75 miles. The coast is lined with sandhills, and these are skirted on the land side by the *étangs* or lakes of Carcans and Canau, and the bay of Arcachon; the lakes communicate with each other and with the bay, which is shallow and studded with islets, and opens into the sea. The greatest length of the department is 106 miles, and the greatest breadth 80 miles. The area is 3761 square miles, and the population in 1882 was 748,703.

The general character of the surface is level except towards the east, where there are some hills; the country west of the Garonne is a dead flat. The principal rivers are the GARONNE and the Dordogne, which unite in this department to form the Gironde; and the north-east is watered by the Isle, an affluent of the Dordogne from the north bank. The feeders of the Garonne which are in the department, with the exception of the Dropt, are all small. In the south of the department the Leyre flows into the Bay of Arcachon. The department is crossed by seven imperial and twenty-eight departmental roads. A railway runs from Bordeaux to La Teste; and another to Poitiers, Tours, Orléans, and Paris. There are also some small branch lines within the department.

The climate is temperate, and, except in the Landes, generally healthy; the sea breezes and the frequent rains temper the heat, which would otherwise be excessive. The Landes, or sandy heaths, of which only a small part has been brought into cultivation, occupy nearly half of the department, extending from the sea to the valley of the Garonne. The sands of the downs along the sea-shore, driven inland by the winds, gradually overspread a considerable tract of country, and formerly encroached yearly from 70 to 80 feet along the whole extent of the coast. The increasing devastation has, however, been checked by planting broom and other shrubs, by means of which the sand has in most parts become fixed. Between the rivers Garonne and Dordogne, and in that part of the department which is to the north of the latter, the soil is chiefly calcareous; it is mingled with considerable districts of sandy and some of gravelly soil, and with rich loamy tracts. The breadstuffs chiefly cultivated are wheat and rye; a considerable quantity of maize and millet are also grown. The rye and millet are raised in such parts of the Landes as have by dint of manure been brought into cultivation. Excellent fruits and a large quantity of hemp are grown. The staple produce of the department is wine, nearly all the claret of France being produced in this department. The finest clarets are from this part of France, comprising the growths of Lafitte, Latour, Château-Margaux (these are in the Médoc district, on the left of the Garonne and Gironde, between Bordeaux and the sea), Haut Brion, Sauterne, Barsac, and the Vins de Grave. The extensive woods which skirt the sea-coast or pervade the Landes consist chiefly of the pine (*Pinus maritima*), from which turpentine, pitch, and charcoal are procured, as well as timber for building and masts for vessels. The cork-tree is abundant.

The Landes are thinly peopled; the inhabitants make charcoal, or tend the numerous flocks which obtain scanty food amid these sandy wilds. The shepherds, clothed in sheepskins, traverse the waste on high stilts, balancing and supporting themselves by the aid of a long staff, of the broad head of which they occasionally make a seat, and which they also use to guide their flocks. They employ their leisure in knitting coarse woollen stockings for their own use or for sale. They travel to markets and fairs on these stilts. Among the sheep of the department are many flocks of merinos, and others of the long-woolled English breeds. The chief manufactures are calico, muslin, soap, chemical products, pottery, paper, vinegar, brandy, sugar, beer, leather, glass, &c. Shipbuilding is extensively carried on in Bordeaux. There are several tobacco factories, dyehouses, and rope-walks; and a great deal of salt is made along the coast.

The department is divided into the six arrondissements of Bordeaux, Blaye, Lesparre, Libourne, Bazas, and La-Réole. The capital of the department is Bordeaux.

GIROND'ISTS (Fr. *Girondins*), the name given to a political party which formed a section of the second National Assembly of the first French Republic, called the "Législative" (in contradistinction to the first or "Constituante," which framed the constitution of 1791). The members of this party were mostly returned by the departments of the west and south; and as their leaders, Vergniaud, Guadet, Gensonné, &c., represented the department of Gironde (Bordeaux), the party received the name of Girondists. They showed themselves from the first hostile to the royal power, and they stood opposed to the constitutionalists,

who wished to maintain the constitution of 1791. Some of the Girondists were republicans, who had formed their notions of liberty on classical models, such as they were then conceived by ardent young men. They had among them some brilliant orators and accomplished individuals, but as a political party they placed themselves in a false position. By their opposition to the constitutionalists they weakened the strength of the middle classes, and left the field open to those who, like Danton and Robespierre, addressed themselves to the turbulent. Instead of taking firmly the true republican position, they were foolish enough sometimes to coquet with the royal party and at other periods to compete with the "mountain" for the favour of the mob—a policy in which, being at bottom honest men, they must of necessity be outbidden. They had power enough, early in 1792, to induce the king to place among his ministers Roland, Servan, Clavière, and Dumouriez, and they seemed for a while reconciled to the constitutional monarchy; but a schism broke out among the ministers. Roland, Servan, and Clavière were dismissed, and Dumouriez soon after resigned. Then came the scenes of the 20th of June and the 10th of August, 1792, which the Girondists indirectly sanctioned, and which destroyed royalty in France. The Assembly dissolved itself and a National Convention was elected, September, 1792, ushered in by those terrible September massacres which still present one of the puzzles of history. In the Convention the Girondists for the most part voted for the death of the king; they tried indeed to obtain a reprieve for him, but in this they failed. They then began to feel their weakness. They struggled for several months against the ascendency of the "mountain" or terrorist party, which was supported by the mob. The Girondists wished for legal forms; they denounced the popular massacres, but they had no support out of doors to depend upon. At the same time they excited the republican enthusiasm of the French, and it was Brissot, one of their leaders, who proclaimed the principle of democratic proselytism, afterwards sanctioned by the Convention by its decree of the 17th December, 1792, by which "the people of every country which was entered by the French troops were invited to form themselves into a democracy, under pain of being treated as enemies should they prefer to retain their ancient form of government." But all this enthusiasm turned to the profit of the terrorists at home, who were in great part men of the lower classes, while the Girondists were not. The latter endeavoured to create an opposition in the departments to counterbalance the influence of the Paris demagogues, but they were denounced as wishing and conspiring to split France into as many republics as there were departments. At last, on the 31st May, 1793, the Convention was assailed by armed multitudes, who demanded the imprisonment of twenty-four deputies of the Girondist party. The Assembly was obliged to give them up, and on the 31st October following twenty-two of them were executed, including Vergniaud, Brissot, Fauchet, Valazé, and Gensonné. Meanwhile in May many Girondists had escaped. Roland, once minister under Louis XVI., was one. Pétion, Louvet, Barbaroux, Guadet, Buzot, and Lanjuinais were also among them. They planned a counter-revolution from Caen, where as many as twenty-seven took refuge. One of the results of their plots was the murder of Marat by Charlotte Corday, friend of Barbaroux. All proved in vain, however, and finally a remnant of twelve, leaving Caen, managed after hardships to reach Quimper on the coast, and so by ship to Bordeaux. Louvet did veritably escape, by the daring course of returning to Paris; others were caught; Buzot and Pétion, with Barbaroux, lived in hiding till the summer of 1794, when the first two perished, possibly of hunger, for their bodies were found in a field half devoured by wild dogs, and the latter shot himself on a false alarm. A month or so more and the death of Danton and Robespierre had saved them. Ex-minister Roland, when he heard that his wife was guillotined as a friend of the Girondists on 8th November, 1793, had refused to "live longer on an earth polluted with crimes," and leaving his safe retreat at Rouen, and carefully writing down thus his reason, thrust a cane sword through his heart, and was so found dead sitting against a tree trunk (16th November, 1793). A few Girondists escaped altogether and reappeared again in the Convention after the fall of Robespierre.

GIRONS, ST., a town of France in the department of Ariège, situated on the right bank of the Salat, 26 miles west of Foix, and at the foot of the Pyrenees. It is a pretty little town, and has a population of 5000. The chief fabrics are linen, coarse woollens, and paper; the town has also a good trade with Spain in iron, wool, mules, and swine; it has ten great yearly fairs, at which there are extensive sales of cloth, linen, corn, and cattle. There is a tribunal of first instance and a college in the town.

GIR'VAN, a market-town and seaport of Scotland, in the county of Ayr, beautifully situated at the mouth of the river Girvan, on a fine bay, about 20 miles S.S.W. from Ayr and 429 from London by rail. The harbour is small, and has a pier, erected a few years ago, which has facilitated the shipment of coals and grain. The extension of the railway to this point has given increased importance to the town. Weaving and fishing are the chief occupations of the inhabitants, many of whom are Irish. The population in 1881 was 4505. The town commands a full view of the sea, the north coast of Ireland, the rock of Ailsa, the Mull of Cantyre, and the various islands lying in the Frith of Clyde.

GIU'LIO ROMA'NO, the most celebrated scholar of Raphael, was born at Rome in 1498, and died there in 1546, hence his surname of *Romano*, the Roman. His real name was Giulio de' Giannuzzi, and he was sometimes called Giulio Pippi. Giulio Romano inherited his great master's feeling for classic beauty and his accurate and powerful drawing, but he is far behind Raphael in grace of design and in beauty of colouring. He is well represented in the National Gallery by his "Mary Magdalen" and his "Capture of Carthagena." He frequently worked with Raphael on the same canvas, and was intrusted with every professional secret. He was even requested by the dying master to finish the pictures left partly done; and it is quite impossible to detect his work, so closely does he follow Raphael's methods. In the famous Loggia of the Vatican his work and Raphael's are distinct and may be compared. Raphael left much of his property to this favoured friend and pupil. Giulio Romano, like his great exemplar, and to a greater degree, studied architecture. The famous Palazzo del Te at Mantua was designed and built by him for the duke (Frederick Gonzaga), and contains in addition a splendid series of paintings from his hand in fresco, and exquisitely fine plaster decorations. He was a man of varied resource, and was as good an engineer as he was an architect. Herein he followed the example of Michael Angelo. Giulio Romano drained the marshes surrounding Mantua with the greatest skill and success, and converted what was a very unhealthy city into a delightful residence.

GIZ'ZARD, the muscular or pyloric division of the stomach of birds. In these animals the stomach is divided into two parts. The lower œsophagus (the canal which is continued from the crop to the stomach) first dilates into a cavity called the proventriculus, or glandular division of the stomach; this has a very vascular lining membrane, and is furnished with numerous large follicles, or glands, placed between the mucous and muscular coats, which secrete a solvent fluid very similar to the gastric juice in mammalia. This first division of the stomach mostly terminates immediately in the gizzard, which is situated below the liver, on the left side of the abdomen, resting on the

intestines. This organ has more or less a lengthened form, and is furnished at its upper part with two openings, the cardiac and pyloric, which are close together; the former communicates with the proventriculus, and the latter with the intestines. Below these openings the gizzard dilates into a pouch, in the middle of the anterior and posterior sides of which is a tendon with muscular fibres attached. In birds of prey, whose food is easily digested, the gizzard is a mere membranous cavity; but in the graminivorous birds it is furnished with muscles of great power, which are arranged in four masses; the two largest, which are situated anteriorly and posteriorly, are connected with the central tendons, and are called the digastric muscles; between these are two thinner ones.

The lining membrane of the gizzard is very hard and thick, and opposite to the digastric muscles two callous spots are formed by the pressure and friction. The muscles take up so much room in the stomach of graminivorous birds that the crop is a necessary appendage to the gizzard, and transmits the food, little by little, to be digested. The food is triturated in the gizzard by the immediate agency of hard foreign bodies, as sand and gravel, which the birds swallow; these bruise the grains of corn by the action of the muscles, and deprive them of their vitality, when the gastric juice acts upon and dissolves them. The pebbles thus perform the office of teeth.

Hunter inferred that the action of the great digastric muscles of the stomach in birds was rotatory, and says, "Although the motion of the gizzard is hardly visible, yet we may be made very sensible of its action by putting our ear to the side of a fowl while it is grinding its food, when the stones can be heard moving one upon another."

GLA'CIERS are those moving masses of compressed snow and ice that occupy the valleys of certain elevated areas whose higher portions extend above the snow-line.

In high latitudes glaciers extend to very low altitudes, but as their dimensions are very variable, and dependent on certain physical conditions for their extended development, in temperate regions they often, and even in torrid zones they may extend a considerable distance below the line of perpetual snow; but although constantly undergoing waste along their course below that line, they do not terminate till the rate of melting is sufficiently high to compensate for their forward movement. When this is so the glacier is replaced by a turbid river emerging from beneath its snout. Where the glacier ends there is always a large accumulation of stones and other debris: these are the materials that have been conveyed along by the moving ice and deposited on the glacier ceasing to exist.

Glaciers being the outlets of the snow-field, carry off the excess of snow deposited above the snow-line, thus representing rivers in less rigorous districts. The moisture condensing on areas whose temperature is below 32° Fahr. is precipitated in the frozen state; a small portion of this is removed by evaporation, but the residue might be increased indefinitely, were it not that the weight of the constant accretion forces the peripheral portions continually outward, which in seeking the lowest level are naturally forced or squeezed into the valleys, where becoming compressed and consolidated they move onward as separate, solid, and compact masses of ice.

Glaciers are therefore the tongue-like prolongations of the snow-cap, which occupy the adjacent valleys for some distance below the snow-line; they are fed by the accumulations of perpetual snow—the snow-fields—of high altitudes. The amount of supply affects their size, and this with their rate of movement largely influences their lower limit, or the distance to which they extend below the snow-line.

Above the line of perpetual snow the snowfall is largely in excess of the waste; along the snow-line the one counterbalances the other; while below that line the waste is in excess, and increases on descending to lower regions. Glaciers remove this excess from the snow-field, and are subjected to waste by evaporation and melting below the snow-line; they therefore gradually diminish in size, till finally they give place to a river.

For the extensive developments of glaciers several conditions are essential:—

1. There should be a considerable high area above the line of perpetual snow, for unless there is a large gathering ground and an abundant supply the glaciers will be of limited proportions. The altitude of the snow-line, which is from 15,000 to 17,000 feet above the sea-level in the tropics, decreases towards the poles. Since, therefore, there are larger areas under perpetual snow in temperate and frigid zones, glaciers are developed there on a more extensive scale than in the tropics.

2. There should be an abundant precipitation of snow. For this condition to be fulfilled proximity to a large expansion of water is almost essential, as from it the moisture which subsequently condenses is derived.

3. A considerable range of temperature is requisite in order to promote the transference of the snow into glacial ice. On high altitudes the snow falls in a loose, dry, and granular condition; this, under pressure or by alternate thawings and subsequent freezings, becomes compacted into *nevé* or *firn*, which on further compression passes into compact glacial ice. The structural peculiarities of this ice, and other phenomena in connection with glaciers, are superinduced by their constant motion and by the fracture and regelation of the ice.

The motion of glaciers has been carefully studied by several accurate observers, who have found that it is analogous to the motion of rivers. Thus the central portion of a glacier moves more rapidly than the sides, and the surface than the bottom. The rate of motion increases with the slope and with an increase of depth; it is affected by the season and surrounding temperature, being most rapid in hot weather. The line of swiftest motion does not coincide with the central line of the glacier, but is more sinuous than the channel, at curves approaching the concave side. In the Alps the average rate of motion is about 30 inches per day.

The surface of a glacier is rough and uneven, and on it there is always a greater or less quantity of stones, clay, and other debris. These are protective to a certain extent, preserving the subjacent portion from the sun's heat and waste, that portion on which they rest becoming elevated above the surrounding surface; individual rocks resting on pedicels of ice form the so-called "glacier tables." The majority of the blocks extend in lines—MORAINES—parallel to the direction of motion. One such line always extends along each side of a glacier; these are the *lateral moraines*. Between these lines there are frequently several parallel rows of blocks—*medial moraines*. Each of these represents the junction of a tributary glacier—the two adjacent lateral moraines uniting to form one medial moraine, while the external one of each glacier forms the lateral moraines of the combination. The blocks forming these accumulations are derived from the slopes of the valleys along which the glaciers have travelled.

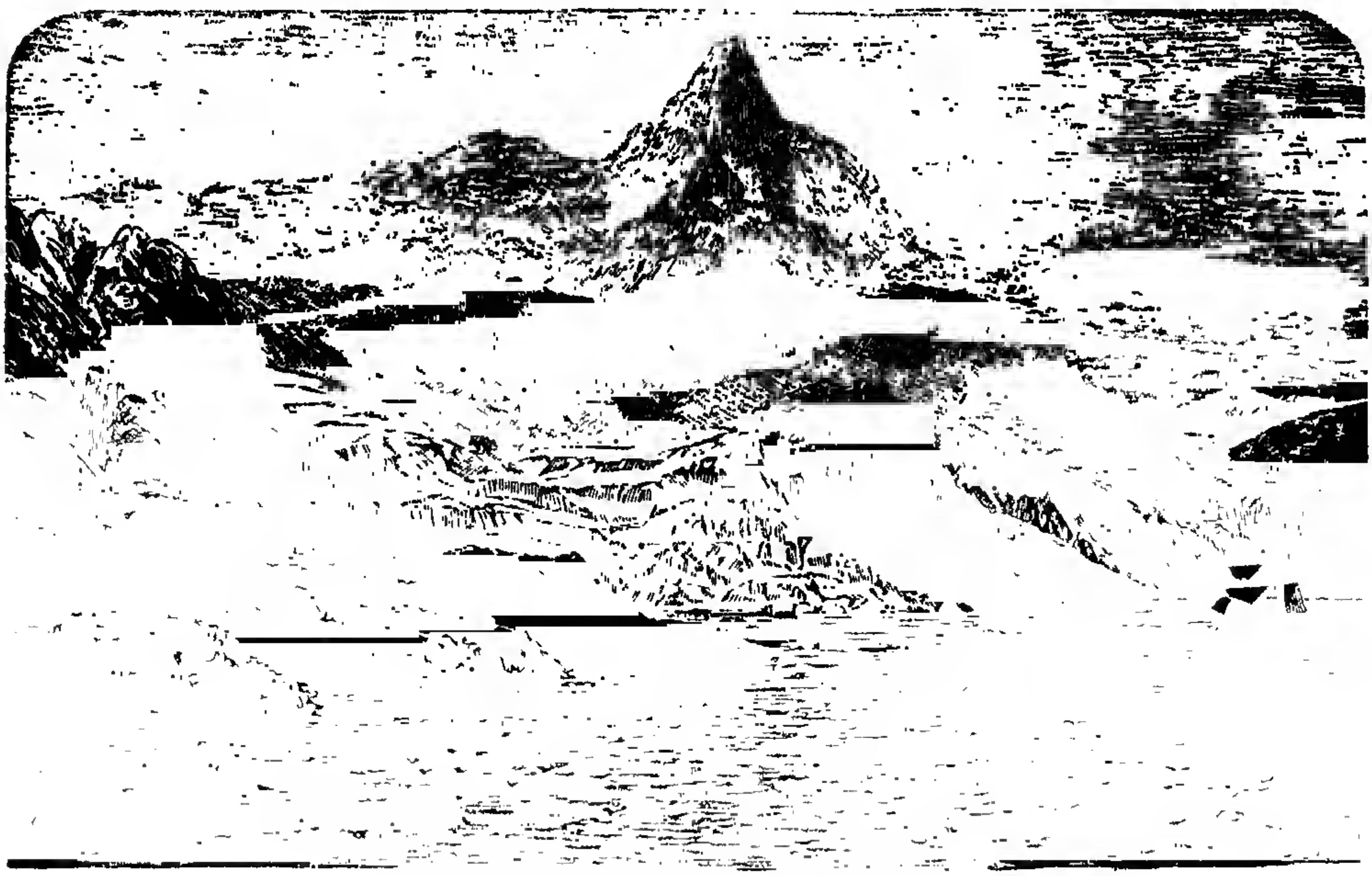
Glaciers along certain portions of their course are frequently scored by deep and wide transverse clefts; these CREVASSES are formed by the fracture of the glacier when a sudden increase in the inclination of the bed produces an ice-fall. Although each individual crevasse moves forward with the glacier, one is incessantly reformed at the top of the ice-fall. The surface-drainage of the glacier, which not unfrequently is very considerable, precipitates itself down the uppermost of these chasms, and being charged with stones, gravel, &c., and constantly falling in the one place, erodes in the rock-bed a deep cavity or pot-hole; these are the *moulins*.

As geological agents glaciers transport, erode, and deposit material. Their most important function is the transference of heterogeneous rock-debris and large blocks of stone from their upper reaches, and the deposition of this stuff at their lower extremity in the *terminal moraine*. This transportation takes place mostly on the surface, the material being deposed in moraines. The extended parallel arrangement of the surface stuff is produced by the frequent dropping on the moving ice of rock fragments from the adjoining cliffs and slopes. A certain quantity of material is inclosed in the ice, but the total amount is probably comparatively small. On the formation of a crevasse the surface debris contiguous to the break finds its way to the bottom; of this, however, the larger blocks during the forward movement of the mass are gradually worked to the surface; while the smaller portions, becoming imbedded in the ice, score and polish the rocks over which the glacier ploughs, producing those characteristic ice-worn surfaces, "glacial striæ," "roches montonnées," &c. Beneath glaciers there is generally a certain proportion of debris, or *grund moraine*, but the infraglacial stream, flowing beneath the ice when it is forced into narrow valleys, washes away the fine material, and by the abrasion and rounding of the larger pieces the total amount of gravel is generally small.

Erosion is mostly effected by the material beneath and imbedded in the glacier; a small amount is also probably produced by the abrasion of the infraglacial stream, and to a less extent by the water charged with gravel which is precipitated down the crevasses. When the latter remain constantly in the one position, as in the case of an ice-fall, deep holes, pot-holes, and GIANTS' KETTLES are excavated.

The efficacy of glaciers as erosive agents is well illustrated in the vicinity of most mountain groups that either recently or during past geological time have been subjected to glacial influences. Valleys and glens are widened and deepened; cooms, corries, and lakes are excavated; crags and rough features are rounded and smoothed down, giving the country a more undulating aspect.

The main mass of deposition by a glacier takes place in



Glacier of Mount Sarmiento, Falkland Islands.

that large conglomeration of transportation, the terminal moraine; but the quantity of fine sediment that emerges in suspension in the water from beneath the snout of a glacier is very large, and is often carried considerable distances before being finally deposited. This fine rock-debris (flour of rock) is derived partly from the rock bed and partly from the fragments imbedded in the ice, each of the latter having one or more of its sides flattened, scored, and polished from its abrasion on the rock bed. BOULDERS, PERCHED BLOCKS, ERRATICS, &c., have been in many instances deposited by glaciers. They occur often in most precarious positions, and mark the former wider extension of glacial conditions. Exclusive of the Arctic and Antarctic regions, glaciers now occur only in a few comparatively small patches, in favourable districts, on the surface of the earth. In Europe they are probably most largely developed in Scandinavia, where in the northern part some few reach sea-level. In past geological time these had a far wider extension, and there is evidence to show that they spread far out into the German Ocean and united with the now extinct system of the British Isles. In the Alpine district the glaciers are better known and have been more carefully studied; one of the largest is about 15 miles long by 3 wide, and from 100 to 600 feet thick. In comparatively recent times the area under glaciers in this district was much greater than now; the great plain of Switzerland was hidden under one vast mass of ice, that conveyed blocks of protogine, gneiss, and other characteristic Alpine rocks, and deposited them high on the flanks of the Jura Mountains. At that time Geneva and most of the other Swiss lakes were scooped out. On the Italian side of the range their extension was not less. The glaciers spread far out over the plains of Lombardy, and have left behind as monuments of their former potency huge masses of moraine matter and the excavations now filled by the Italian lakes. Of these cavities Maggiore is 1800 feet deep, being 1122 feet below sea-level.

One of the most remarkable of all the Alpine glaciers is the Mer de Glace, near the village of Chamouni. Streaming down a broad valley in the mountains, it looks like a rugged river of ice, the more remarkable for being seen to pursue its way amidst woods and fields bright with verdure. Its length from its mountain source to its termination in the valley of Chamouni is nearly 9 miles, and its breadth over half a mile. To the eye its motion is not observable, but by daily markings in relation to the rocky margin the rate of flow is found to be about an inch per hour, in winter only half as much. Meeting with sudden declivities in the course of its bed the ice-river frequently cracks and forms the clefts or crevasses of such evil reputation for Alpine climbers. These clefts are of a width of from 20 to 50 feet, and from 100 to 200 feet deep, and have been the occasion of innumerable accidents to tourists. The splitting of the ice on a change of weather, or in consequence of unequal pressure on an uneven bottom, shakes the very hills, and produces a noise which, reverberated from the mountains, sounds like thunder.

In Asia, besides the glaciers of the north, there are gigantic ones in the Himalayas; but evidently they are only the shrunken remnants of a wider extension.

In New Zealand there is a very typical development of glaciers, and some on a large scale. In some cases they extend to within 500 feet of sea-level, and have a sub-tropical vegetation of tree ferns, &c., at their extremity. As in the northern hemisphere, there is evidence of their having been formerly much larger.

Along the Andes of South America glaciers are also found, and in Chili, at about the latitude of Paris, they reach the sea-level. The glacier of Mount Sarmiento, Falkland Islands, is shown on the preceding page.

In North America, along the Pacific slopes, they also occur, especially in the Sierra and Cascade ranges; their extension here during the glacial period was very great. In the Arctic regions of North America and in Greenland the greater portion of the land is under a permanent ice-cap, that sends glacier prolongations of great size into the sea; thus the Humboldt glacier is 45 miles wide at its face and 300 feet thick. In Antarctic regions the glaciers probably exceed even these dimensions.

When a glacier terminates in the sea the ice, instead of all melting, breaks off in large masses and floats away as ICEBERGS, which may bear glacial debris to immense distances.

We have little direct evidence of the occurrence of glaciers during the earlier geological epochs, but it is not unreasonable to suppose that they did exist, and some of the breccias and conglomerates of the Tertiary age are favourable to this opinion.

GLA'CIS, an elevation of earth surrounding a fortress on the exterior of the covered-way, to which it serves as a parapet, while it protects the ditch and wall from direct fire. See FORTIFICATION.

GLAD'IATORS were men who fought with swords (Lat. *gladii*) and other weapons in the amphitheatre and public places for the entertainment of the Roman people. They were either slaves, prisoners, or convicts, and as such obliged to fight; or volunteers, who exhibited for money. The most favourite fight was that between a gladiator armed with sword and shield and one armed with a trident and a net, with which he sought to entangle his adversary. When one of the combatants was overthrown, his competitor, standing over him, asked the verdict of the spectators; if he had well fought they turned down their thumbs, and his life was spared; if the thumbs were turned upwards, one stab ended his life. Gladiators were exhibited at many great festivals for the amusement of the spectators; and the amount of human life thus wantonly sacrificed was increased enormously in the later times of the Roman republic and under the empire. [See GAMES.] The practice was defended even by grave men, as serving to keep up a martial spirit and a contempt of death among the people. Gladiators first fought at Rome B.C. 264. The passion grew till 10,000 fought in one series of games, celebrating Trajan's victory over the Dacians. Constantine, A.D. 325, prohibited gladiators' fights, but the practice, it is said, was not totally extinct in the west till the time of Theodoric. In the year 76 B.C. seventy-four gladiators at Capua rose against their master, overpowered the guards, and fled to the mountains, where they were joined by thousands of runaway slaves and peasants. Being led by a gladiator of the name of Spartacus, a Thracian by birth, and a man of superior abilities, they defeated several Roman armies. Their camp was in the grassy hollow at the top of Vesuvius, then quiescent. They were finally overpowered by the prætor M. Crassus, and Spartacus was killed.

GLADIO'LUS, a genus of plants of the order IRIDEÆ, with bulbous roots and sword shaped leaves. The Cape of Good Hope produces the greater number of the known species, but a few are natives of other countries. The flower is of great beauty. The bulbs of some of the species contain a quantity of starch, and are used as an article of food by the natives of South Africa. The perianth is generally irregular, with a curved tube and a six-parted somewhat two-lipped limb. There are three stamens inserted in the tube, unilateral and arched. One species, *Gladiolus illyricus*, is a native of England; it is found in the New Forest, and appears to have formerly grown in Dorsetshire.

GLADSTONE, THE RIGHT HON. WILLIAM EWART, statesman, orator, and man of letters, was born at Liverpool on the 29th December, 1809. His father, Sir John Gladstone, was an eminent and successful merchant of that city, whose efforts in the promotion of trade and commerce won the very high esteem of his fellow-townsmen and friends, and were recognized in 1845 by Sir Robert Peel, by whose advice Mr. John Gladstone was created a baronet. Sir John sat in the House of Commons for nine years, representing during a portion of the time the small pocket borough of Woodstock. The subject of our present notice is the son of Sir John by his second wife, Miss Ann Robertson. He is of Scotch descent on both sides, and has sprung from the ranks of that powerful order which has justly been regarded as the backbone of the kingdom, namely, the middle class. Burke pretty clearly connects the family of Gladstone's mother with a royal descent from Henry III. of England and Robert Bruce, king of Scotland. What was of more consequence to the Gladstones of recent generations, however, than royal blood, was the fact that they carved their own fortunes, and rose to positions of public esteem and eminence.

The afterwards illustrious statesman gave early evidence of considerable intellectual power, a characteristic which received wise development at the hands of his earliest preceptor, the venerable Archdeacon Jones, himself a man of solid acquirements and sterling uprightness of character. There were in the lad many signs of that precocity which too often is quickly extinguished for lack of physical fuel, or degenerates into mediocrity as manhood approaches; but with a sturdy physical constitution and a mind of corresponding vigour young Gladstone contrived to avoid both these perils. In 1821 he was entered at Eton, and remained there till 1827. He was mainly instrumental in launching the *Eton Miscellany*, and was its most voluminous contributor, among others being G. A. (afterwards Bishop) Selwyn, F. H. (afterwards Sir Francis Hastings) Doyle, and Arthur Henry Hallam. Both poetry and prose contributions were so prolific as to leave but little leisure for the ordinary sports of Eton boys; and, as in some of the early writings of his great political

contemporary and rival, Lord Beaconsfield, there were occasional passages which showed the bent of the youthful mind. In a paper on "Eloquence" he dwelt upon how the vision of the most ardent and aspiring minds is usually directed towards St. Stephen's. "A successful *début*," he wrote, "an offer from the minister, a secretaryship of state, and even the premiership itself, are the objects which form the vista along which a young visionary loves to look." He was not insensible to the chilling ordeals which may await an aspirant to the House of Commons, the roars of coughing as well as roars of cheering, and maiden speeches which often come to grief; but derived encouragement from the fact that among the most distinguished speakers in the House at that very time were Lord Morpeth, Edward Geoffrey Stanley, and Lord Castlereagh, all formerly members of the Eton College Debating Society. Leaving Eton in 1827, Mr. Gladstone became the private pupil of Dr. Turner, afterwards Bishop of Calcutta. Two years later he went to Christ Church, Oxford, where he was made a student on the foundation. In the year 1831 he went up for his examination, and completed his academical education by attaining the highest honours of the university, graduating double first-class. To a very great extent his Oxford associations gave the tone to the whole future career of Mr. Gladstone. It was in the debates of the Oxford Union that the young undergraduate learned to think and speak upon political subjects; while the current of thought which prevailed here at this time, just on the eve of the tractarian movement, was such as to leave a strong impression upon a mind naturally imbued with deep moral fervour and a religious spirit. From 1829 to 1834 was the most active and brilliant period in the history of the Union, and it may be remarked that among its presidents or leading members were several who subsequently were included in Mr. Gladstone's ministry, such as Lord Selborne, Mr. Lowe, Mr. Cardwell, Mr. Goschen, Mr. Knatchbull Hugessen, &c., in addition to Mr. Sidney Herbert, Dr. Tait, the late Archbishop of Canterbury, and Cardinal Manning. It was here and at this time that Mr. Gladstone acquired from conviction as well as prejudice a spirit of devoted loyalty, of warm attachment to the liberties and ancient institutions of his country, a dislike and dread of rash innovations, and an admiration approaching to reverence for the orthodox and apostolic English Church; and it is not very surprising that, thus influenced, he cast in his lot for the time with the Tories and High Churchmen.

Closing his university career in 1831, Mr. Gladstone spent some time in continental travel, and was in Italy during the period of feverish political excitement which prevailed during the passing of the Reform Bill of 1832. He hurried back to contest the borough of Newark, at the invitation of the Duke of Newcastle, whose influence was supposed to be paramount there, although the duke's nominee had in the previous year been defeated by Serjeant Wilde. Mr. Gladstone was returned at the head of the poll, and on the 13th December, 1832, was declared member for Newark. His father was the intimate friend and admirer of Canning; and early associations, parental training, and the influences of Oxford, combined to render the young and talented member a Tory of the most pronounced type.

Mr. Gladstone's maiden speech differed widely from the melodramatic *début* of his great rival, Benjamin Disraeli. [See Beaconsfield, Lord.] The leading question in the first session of the reformed Parliament was that of the abolition of slavery in the British colonies; and in support of a statement as to an alleged unusual destruction of human life in the West Indies, owing to the way in which slaves were worked, reference was made to an estate in Demerara owned by Mr. Gladstone's father. This brought up the new member for Newark, who, on the 14th May, 1833, delivered, in his father's defence, his earliest parliamentary address. Modest in demeanour, earnest in manner, fluent in speech, and with a most comprehensive grasp of his subject, he at once commanded the respect and attention of his fellow-members, and made a most favourable impression upon the House. He subsequently spoke upon the emancipation proposal generally, and while concurring in its propriety urged that the scheme should be very gradual in its effect, so as to give the slaves an incentive to the acquirement of moral instruction and habits of industry, without which liberty would prove a curse instead of a blessing to them. A different view, however, was adopted, colonial slavery being unconditionally abolished, and £20,000,000 being voted to the slave-owners as compensation for their losses.

The new member's speeches in regard to the church and to university questions were in the outset of the most uncompromising Tory kind, but before his second session had concluded it was obvious that, whatever might be the nature of his opinions, a debater of considerable power had been added to the House. Towards the close of 1834 the Whig ministry fell, Sir Robert Peel came into power, and Mr. Gladstone was offered and accepted office as junior lord of the Treasury, changed soon after to that of under secretary for the colonies. But though office came thus rapidly he did not, in the first instance, long enjoy it, for in April, 1835, the ministry were defeated on Lord John Russell's motion to inquire into the temporalities of the Irish Church, and Lord Melbourne again came in.

For about six years Mr. Gladstone was now in opposition, but during this time his speeches on various subjects, especially upon church rates and colonial matters, placed him in the front rank of parliamentary debaters. In the general election consequent upon the accession of Queen Victoria in 1837 he was again returned for Newark, but in opposition to his own wishes he was also nominated as the Conservative candidate for Manchester, and although he issued no address nor put in any appearance 2294 votes were recorded for him, the Liberal candidates receiving 4155 and 3760 respectively. The fact is of much significance as showing the position Mr. Gladstone had already attained in the estimation of one of the greatest commercial centres.

In 1841 Lord Melbourne's ministry, the popularity of which had long been on the wane, came to an end; and now began the memorable administration of Sir Robert Peel, which was destined to achieve a complete revolution in our commercial and financial legislation. Mr. Gladstone accepted office in the new government as vice-president of the Board of Trade, and succeeded the Earl of Ripon in the presidency in 1842. The time was critical, and the ability of the ministry to grapple boldly with serious difficulties was put to a severe test. Commercial stagnation was producing a painful state of distress throughout the country, and the chief cause was suspected to be a highly protective tariff. Free-trade agitation was making strong headway, and Peel, for his supposed protectionist tendencies, was burnt in effigy at Northampton. The budget introduced in 1842 had to deal with a deficit of £2,750,000, and the utmost limit of taxation upon articles of consumption had been reached. The difficulty was met by the imposition of an income tax of 7*d.* in the pound and one or two minor imposts, together calculated to yield about £4,300,000; and secondly, by a very important revised tariff or customs duties scheme, which was mainly the work of Mr. Gladstone. The merit of the budget was therefore its taxation of wealth and the relief of the manufacturing industry. Out of 1200 duty-paying articles a total abolition or a considerable reduction was made in no less than 750. This was certainly a great step towards freedom of manufactures, and may be regarded as the first stroke in the skilful management of finance for which Mr. Gladstone has ever been distinguished. The details of the new fiscal legislation

were left almost entirely to him, and in the session of 1842 he demonstrated a singular power of dealing with such details, and of comprehending the scope and necessities of the commercial interests of the country. In 1843 he introduced and carried his Railway Bill, a measure distinctly in the interests of the poorer classes, providing for at least one third-class train per day upon every line, regulating the speed of travelling, &c., and arranging for the carrying of children at reduced fares. In 1845 the ministry proposed an increase in the Maynooth endowment and the establishment of non-sectarian colleges in Ireland, and both these proposals being at variance with views Mr. Gladstone had advocated in two published works, he resigned. There was something quixotic, however, in his resignation, for as soon as he felt himself free he not only supported the Maynooth Bill, but voted for the non-sectarian colleges, described by that stanch old Conservative, Sir R. Inglis, as "a gigantic scheme of godless education."

In the session of 1842 Mr. Gladstone had defended Peel's sliding scale of protective duties on corn, and an amendment for the immediate repeal of the corn laws had then been thrown out by the enormous majority of 303 in a House of less than 500 members. Towards the close of 1845, however, he issued a pamphlet, "Remarks upon Recent Commercial Legislation," and the arguments used clearly showed that he was advancing to the position of a free-trader. In December it was announced that the government would bring forward a bill for the repeal of the corn laws, and a brief interregnum ensued, consequent upon the defection of several ministers who could not follow the premier's policy. It was at first proposed that Lord John Russell should form a government, but this being found impracticable Peel returned to office supported by most of his old colleagues and reinforced by Mr. Gladstone, who accepted the post of colonial secretary. Such acceptance, however, vacated his seat for Newark, and forfeited the support of the Duke of Newcastle, who was an ardent protectionist. Mr. Gladstone, therefore, bade farewell to Newark, and being thus without a seat, the great government measure of 1846 had not the advantage of his powerful advocacy in Parliament. It was no secret, however, that the policy of the government in regard to repeal was largely moulded by him, and his representations of the effects of free trade on the industry of the country and the general well-being of the people strengthened the premier in his resolve to sweep away the obnoxious corn laws. The pamphlet on recent commercial legislation had prepared the way for the later momentous changes, and to Mr. Gladstone is due much of the credit for the speedy consummation of the free-trade policy of the Peel ministry. In the official sphere he may be regarded perhaps as the leading pioneer of the movement. The bill was introduced into the Commons by Peel on the 27th January, 1846, and passed the Lords on 25th June, but by a singular coincidence the very day which witnessed Peel's triumph also witnessed his overthrow. It was on this same 25th June that the ministers were defeated in the House of Commons, on the second reading of their Irish Coercion Bill, by 292 to 219 votes. Sir Robert Peel thereupon resigned office, and a Whig ministry was formed with Lord John Russell as premier.

At the general election of 1847 Mr. Gladstone was returned for Oxford University, but soon shocked some of his constituents by speaking eloquently for Lord John Russell's proposal to admit Jews to Parliament. The year 1848 was a troubled one for Europe, and, what with revolutions abroad and Chartist riots at home, also one of anxiety for English statesmen. In view of the somewhat absurd fear which generally prevailed of the great Chartist demonstration on Kennington Common special constables were sworn in, and among those who came forward in this service in London were Prince Louis Napoleon (Napoleon III.), Edward Geoffrey Stanley (Earl of Derby), and William Ewart Gladstone. In this year the poor-law board was established, and it is further interesting, from the parliamentary point of view, from the fact that Mr. Disraeli became the formal leader of the Conservative Opposition. It was apparent at this time that changes were taking place in Mr. Gladstone's convictions upon ecclesiastical and other questions, and though still nominally Conservative, the liberalizing tendencies of his speeches often excited the criticism of Mr. Disraeli. Sir Robert Peel's action as regards the corn laws had, in fact, created an independent party, recruited from both sides of the House, known as the Peelites, and in this following were several who looked with large and liberal views upon other questions besides free trade. Especially prominent in this party was Mr. Gladstone. He urged the claim of Jews to equal civil and political rights, strongly deprecated the evils of church rates, advocated the repeal of the navigation laws, and supported Sir William Molesworth's motion for an inquiry into the administration of the colonies. Riots in Canada had opened up the latter subject; and Mr. Gladstone urged Parliament to take immediate steps to maintain that which was even more important than the mere political connection between the colonies and England—namely, the love of the colonies for the mother country, and a desire to imitate the laws and institutions of the great country from which they had sprung. The navigation laws were repealed in 1849, but the question of the admission of Jews to Parliament and that of church rates stood over for some years.

The session of 1851 was chiefly noticeable for a great debate upon the blockade of the Piræus by Sir William Parker, consequent upon the Greek government having refused the claims of certain British subjects to compensation. The orations of Lord Palmerston, who spoke for five hours in defence of his policy, of Sir Robert Peel, Mr. Cockburn, Mr. Cobden, Mr. Disraeli, and Mr. Gladstone were rhetorical efforts of the very highest order. Mr. Gladstone combated Lord Palmerston's *Civis Romanus sum* argument as applied to British subjects, and his speech, which was the most powerful he had yet delivered, had a marked effect upon the House. Sir Robert Peel, almost immediately after speaking in this debate, met with the accident which resulted in his death, and then ensued the disintegration of the small but brilliant band called by his name. Some of its members formally joined the Conservative ranks, but others, such as Sir James Graham, Mr. Sidney Herbert, and Mr. Gladstone, held aloof for the present from either party.

Papal aggression reached in 1851 what were regarded as rather alarming lengths, and Lord John Russell brought in his famous Ecclesiastical Titles Bill, aimed at the assumption of British titles by Roman Catholic bishops, and rendering void all acts done by parties under those titles. The whole country was in a ferment, and ministers carried their bill by the immense majority of 438 to 95. Mr. Gladstone spoke eloquently against the measure, which proved an absolutely dead letter, *Punch* hitting off the case well in a cartoon which represented Lord John Russell as running away after having chalked up "No Popery!" This year Mr. Gladstone published his celebrated letters to Lord Aberdeen on the condition of the Neapolitan prisons and the inhuman treatment of the political prisoners. The letters produced a strong feeling throughout Europe, and formed one of the precipitating causes of the subsequent overthrow of the Neapolitan government—one of the most scandalous governments of modern times. Towards the close of the year Lord Palmerston was dismissed from the office of foreign secretary for having repeatedly acted in advance of the queen's sanction, and especially for taking upon himself officially to approve of the *coup d'état* of Louis Napoleon; early in 1852, however, he defeated his old colleagues on their Militia Bill. The Earl of Derby succeeded Lord John Russell, and a ministry

was formed which included Mr. Disraeli as chancellor of the exchequer. Against his first budget, however, Mr. Gladstone delivered a crushing speech, which gave the death-blow to the financial schemes of his rival. Mr. Disraeli replied with bitterness and equal cleverness, and very lively personal scenes ensued, ending in the defeat of the government by a majority of nineteen.

Lord Aberdeen now became premier, and a coalition ministry was formed, combining Whigs and those who had been known as Peelites. By general consent there could be but one possible chancellor of the exchequer—Mr. Gladstone, and he speedily justified the high expectations of his friends by inaugurating a new and brilliant era in finance. He first brought forward a scheme for the reduction of the national debt; and in his first, and one of the greatest of his budgets, provided for the gradual reduction of the income tax, to expire in 1860; the equalization of the spirit duties; the abolition of the soap duties; the introduction of the penny receipt stamp; the reduction of the tax on cabs and hackney coaches; and the equalization of the assessed taxes. Altogether the duty on 123 articles was abolished, and the duty on 133 reduced—the relief amounting to £5,000,000. This financial scheme met with unequivocal success, and it was regarded as the most able, far-sighted, and practicable of financial measures since Peel's celebrated budget of 1844. The breaking out of the Crimean War necessitated the temporary suspension of some parts of the financial scheme, and Mr. Gladstone was called upon to prepare a war budget, which he did with skill and success. Blunders and mismanagement in connection with the Crimean War services led to the fall of the Aberdeen government in 1855, and to the accession of Lord Palmerston to power as prime minister. The changes in the new cabinet were so few that it was rather a reconstruction than a creation, and Mr. Gladstone continued in his office of chancellor of the exchequer. It was, however, for only a short time. Lord Palmerston accepted Mr. Roebuck's motion for an inquiry into the conduct of the war services, and dissenting from this view Mr. Gladstone, in February, 1856, retired, in company with the other Peelite section of the cabinet. His conduct during the war was much criticised, but he subsequently put forward a lengthy and, in some respects, successful apology for his course during this very critical period.

In 1857 the Chinese seized a lorcha called the *Arrow* while it was showing British colours. It seemed decidedly open to question whether the vessel had any right to carry the British flag, but Lord Palmerston carried the matter with a high hand, and war with China was commenced. When the matter was discussed in Parliament Mr. Gladstone was one of the most effective speakers against the government, who were defeated in a division by a majority of sixteen. Lord Palmerston appealed to the country, and at the poll his enemies were scattered like chaff. Messrs. Cobden, Bright, Milner-Gibson, Fox, and Layard lost their seats, but Mr. Gladstone was returned for Oxford University unopposed. Lord Palmerston's triumph, however, was short-lived, for in 1858 he was defeated on the Conspiracy to Murder Bill, and Lord Derby once more came into power.

One of the most useful measures passed by the new ministry was the India Bill, transferring the government of India to the crown, and Mr. Gladstone succeeded in incorporating an important clause in the measure, providing that the Indian troops should not be employed in military operations beyond the frontiers of India without the consent of Parliament. In November of 1858 he accepted a commission from Lord Derby as high commissioner extraordinary to the Ionian Islands, and went to Corfu. A few years later the islands were formally incorporated with Greece. Mr. Gladstone's industry and ability were further testified at this time by the appearance of his important work—his *magnum opus* in literature—"Homer and the Homeric Age," a work exhibiting great research.

The Derby government came to grief over their reform bill in 1859, and with Palmerston again as prime minister Mr. Gladstone once more became chancellor of the exchequer. He now commenced and carried out a series of splendid and memorable achievements in finance. By the assistance of Mr. Cobden a commercial treaty with France was concluded on free-trade principles, and remained in force until the year 1882. The budget was awaited with intense interest, and to a House crowded beyond all precedent on such an occasion Mr. Gladstone announced, on the 10th February, 1860, a relief of £2,146,000 from payment of interest on the national debt; the duties on butter, cheese, oranges, tallow, and a host of minor articles were abolished; the duties on timber, currants, hops, &c., were reduced; and there were other beneficial changes, including the abolition of the paper duty. The Paper Duty Bill was rejected by the Lords, but all the other proposals of the chancellor were carried, and contributed immensely to the popularity of the government. Continuing his career of useful legislation for the people, Mr. Gladstone in 1861 carried through a bill establishing post-office savings banks, a measure which has proved a great boon to the community. By the budget of this year the income tax was reduced 1*d.* and the paper duties were abolished, Mr. Gladstone circumventing the Lords by including his chief financial propositions in one bill. Cheap newspapers had certainly existed in spite of this last remnant of the "taxes on knowledge," but the relief afforded by its abolition was at once seen in the improvement and increase of cheap literature of all classes. Less popular than this measure was a speech made by Mr. Gladstone at Newcastle about the close of 1862, in which, referring to the civil war then raging in the United States, he expressed the opinion that Mr. Jefferson Davis had already succeeded in making the Southern States of America an independent nation. Not only were most of the chancellor's warmest friends ardent defenders of the North, but Earl Russell had just before declined to recognize the Confederate States as a separate and independent power. A surplus in the annual budget was now looked for as a matter of course, and in 1863 it was one which allowed of 2*d.* being taken off the income tax and the reduction of the tea duty to 1*s.* A proposal, however, to subject charities to the income tax met with such powerful opposition as to cause its withdrawal. The proposal was on the ground of principle rather than of finance, for in spite of its abandonment there was in 1864 a surplus of £3,231,000, and by further reduction in the income tax, tea duty, &c., relief in taxation was given to the extent of no less than £5,420,000. The chancellor's calculations were fortunately aided and verified by the continued prosperity of the country. In July, 1865, Parliament was dissolved, and at Oxford Mr. Gladstone found himself opposed by Mr. Gathorne Hardy, who, as an uncompromising defender of the church, was preferred to the more brilliant statesman and financier. Driven from Oxford he went down to South Lancashire, for which division, after a spirited contest, he was returned with two Conservative colleagues. In May, 1866, Mr. Gladstone brought forward what was destined to be his last budget for some years, and, as formerly, there was a surplus, followed by a remission of taxation to the extent of about £1,500,000.

Various abortive efforts had been made by different governments to settle the reform question, and Earl Russell, who had succeeded to the premiership upon the death of Lord Palmerston in 1865, now resolved to introduce a measure having a liberal and extensive scope. The bill proposed to create an occupation franchise in counties, including houses at £14 rental, to establish a savings-bank franchise, a lodger franchise, and other new suffrages, so that altogether the new voters of all classes would number 400,000. In the light of what has since been done in the way of extending the franchise, such a reform

bill seems a very moderate measure. It encountered the opposition, however, not only of the Conservatives, but of an influential section of the Liberal party, led by Mr. Lowe, Mr. Horsman, Lord Grosvenor, and others—known, after Mr. Bright's famous simile, as the Adullamites. In spite of all this the bill passed its first and second readings, and then it was unexpectedly wrecked on a motion of Lord Dunkellin substituting rating instead of rental as a basis for the borough franchise. Regarding this as a vital point the government resigned, and a new administration was formed by Lord Derby. The failure of the reform legislation, however, excited such strong feeling in the country that the new government felt bound to deal with the matter, and Mr. Disraeli, although opposing the previous bill, set about educating his party up to the point of passing a still more sweeping measure. The principles of his scheme were that in boroughs the electors should be all who paid rates or 20*s.* in direct taxes; the franchise would also be extended to certain classes qualified by education, or by the possession of a stated amount in the Funds or in savings banks; rated householders to have a second vote. There would be a redistribution of seats, and to guard against the power of mere numbers it was proposed to establish a system of checks, based on residence, rating, and dual voting. The bill was introduced in a House of Commons with a nominal Liberal majority, and one in which Mr. Gladstone had only been beaten by a combination of his own party. A reform bill brought in by a Conservative minority was obviously therefore at the mercy of the majority. Accepting the proposition that borough electors should be all who paid rates, Mr. Gladstone proposed a series of amendments by which the dual votes and fancy franchises were almost completely eliminated, a lodger franchise established, and the whole aspect of the bill so completely changed as to render it but the shadow of its former self. Had Mr. Disraeli possessed a working majority it is probable that either of Mr. Gladstone's ten leading amendments would have been resisted as fatal to the principle of the measure, but under the circumstances discretion was the better part of valour, and they were accordingly accepted. The House of Lords would probably never have passed what was now so drastic a bill, but that its rejection meant the upsetting of a Conservative government; so with many misgivings it was passed by the Upper House, even the premier, Lord Derby, describing it as a "leap in the dark."

In February, 1868, Mr. Disraeli became prime minister on the retirement of the Earl of Derby. Mr. Gladstone now introduced a Bill for the Abolition of Compulsory Church Rates, which was passed, and on the 16th March he struck the first blow in the struggle which was to end in the disestablishment of the Irish Church. During the debate on a motion by Mr. Maguire he made the important declaration that religious equality must be established in Ireland, difficult as the operation might be. This resolve became the basis of action for the Liberal party, and the country speedily took up the cry of disestablishment. Mr. Gladstone proposed a series of resolutions declaring that the time had come when the Irish Church should cease to exist as an establishment, and the battle began, the speaking on both sides being extremely able. Mr. Disraeli replied to Mr. Lowe in language of strong invective, and with reference to the assertion that the hour and the man (Mr. Gladstone) had come on this question, he said, "I believe the clock goes wrong and the man is mistaken." The resolutions, however, were carried, and an Irish Church Suspensory Bill was also passed by the Commons, but rejected by the Lords. The question was now remitted to the new constituencies, and at the general election in November a great Liberal majority of about 115 was returned, although several signal individual defeats were sustained. Mr. Gladstone himself was rejected by South Lancashire, but was immediately returned for Greenwich by a large majority over the Conservative candidates. Seeing the strength of the national verdict Mr. Disraeli resigned office, and Mr. Gladstone succeeded to the premiership.

Now began a remarkable period of legislation, a period which, in view of the vast reforms effected, has been called the "golden age of Liberalism." After protracted debates and great excitement in the country the Irish Church Disestablishment Bill became law, followed in 1870 by the Irish Land Bill, a measure mainly for insuring to the tenant, among other things, greater security of holding. Education Acts for Great Britain were passed, and in 1872 the Ballot Bill was carried. Some valuable domestic Acts were also passed, dealing with the public health, licensing, adulteration, the regulation of mines, and the purchase of the telegraphs by the state, succeeded by the introduction of the halfpenny post, in the form both of stamps and post-cards. In our article on the POST OFFICE a comparison of the business of that department in 1870 with that of the present time will sufficiently show the enormous advantages secured to the community by the changes mentioned. Purchase of commissions in the army was abolished by royal warrant after the rejection by the House of Lords of an Army Regulation Bill which had passed the Commons. The vexed question of the ALABAMA CLAIMS was also finally settled by arbitration, although on terms not very satisfactory to England, which was adjudged liable in damages amounting to £3,000,000 sterling, but not without a powerful protest on some points by our arbitrator, Sir A. Cockburn. Signs were not wanting, however, that the popularity of the ministry was waning. Such vast changes had been accomplished that men began to say they were being reformed off their feet. The Irish Church policy had aroused the clerical class to hostility; the licensed victuallers were offended at the Licensing Act, as was the military party with the purchase warrant; and many other interests, rightly or wrongly, had taken umbrage at the government. Ultimately, in attempting to grapple with the Irish university question, Mr. Gladstone was defeated by three votes, 287 against 284, and resigned. Mr. Disraeli was sent for, but refused office; Mr. Gladstone therefore resumed his post, 16th March, 1873. Considerable changes were made in the cabinet during the following autumn, Mr. Gladstone himself taking the office of chancellor of the exchequer; but the government had lost prestige and popularity. The by-elections during the recess continued to go against the Liberals, and in January, 1874, a fortnight before both Houses were to have met, Mr. Gladstone took the whole country by surprise by suddenly dissolving Parliament. The result was not favourable to his expectations, and although able to lay before the country a distinguished record of Liberal services and measures, and to show a surplus of the enormous sum of £6,000,000, the elections resulted in the triumph of the Conservatives, who gained a clear majority of forty-six.

Mr. Disraeli now came into office with a substantial working majority, and for a time Mr. Gladstone resigned to Lord Hartington the Liberal leadership. He occupied himself in the meantime with ecclesiastical controversy—his essay on ritualism, his pamphlet on the Vatican decrees, and other cognate publications, exciting widespread interest and controversy. But the Eastern question again brought him into the domain of politics. The spirit of the old enthusiasm against tyranny once more awoke within him, and the country thrilled with his fiery condemnation of the Bulgarian massacres. He reviewed with severity the government policy on the Eastern question, and Mr. Disraeli, now Lord Beaconsfield, had no longer reason to complain of the silence of his ancient foe. The Conservative foreign policy in 1878–79 found in Mr. Gladstone a sleepless critic. He condemned the despatch of Indian troops to Malta as unconstitutional, pointed out the dangers of the ministerial policy, described

the Anglo-Turkish Convention as an "insane covenant," denounced our new responsibilities in Asiatic Turkey, adversely criticised the proposed scientific frontier in India, and strongly condemned the Afghan War and the assumption by the queen of an imperial title. He also attacked the financial policy of the government, and here had no difficulty in planting many serious and well-directed blows. While, however, the strength and vehemence of the oratory were with Mr. Gladstone, the votes of Parliament were with Lord Beaconsfield; and the latter, who ever prided himself upon an apparent imperturbability, pursued his imperial policy undisturbed.

At last Mr. Gladstone resolved upon an important step. In the autumn of 1879 he was invited to contest the seat for Midlothian, and accepted the invitation. He accordingly went north in December, and accomplished an oratorical and intellectual feat unparalleled in the history of any statesman who had attained his seventieth year. In the course of a fortnight he addressed about twenty audiences, numbering 75,000 people, while 250,000 persons took part in the demonstrations evoked by his visit. In March, 1880, Parliament was dissolved, and it was now seen that the determined and enthusiastic manner in which Mr. Gladstone had made war upon Lord Beaconsfield's policy had acted as an inspiration to the whole country. In every direction Conservative seats fell to the victorious Liberals, Mr. Gladstone himself ousting the Tory member, the son of the Duke of Buccleuch, from Midlothian. The verdict of the country was emphasized by a majority to the Liberal party far greater than that which the Conservatives enjoyed in 1874. Lord Beaconsfield resigned, and by a strong consensus of public opinion the one man for the premiership was he who had led the party so triumphantly into power. Accordingly, after some little hesitation, Mr. Gladstone again became prime minister, his cabinet including Lords Granville and Hartington (each of whom had declined the premiership in his favour), and a strong section of the advanced Liberal element.

A Coercion Act for Ireland became necessary in 1881, on account of the insecurity of life and property; but Mr. Gladstone accompanied this by a second Irish Land Act, conferring great and unprecedented advantages on Irish agricultural tenants, the chief being a revision of their rents by a specially constituted tribunal, and the power of selling their "tenant right" to the highest bidder. In 1882 the assassination of Lord Frederick Cavendish, who had just been appointed chief-secretary to the Lord-lieutenant of Ireland, and of Mr. Burke, the permanent under-secretary, led to the passing of a stringent Act for the Prevention of Crime, all classes of the community having been overwhelmed with horror at the infamous deed. It was not allowed, however, to prevent the passing of other measures for ameliorating the condition of the Irish tenantry. Of the new Acts passed with this view the most prominent were those dealing with arrears of rent, the surplus Irish Church property being appropriated to assist in removing these; and the Act passed in 1884 for loan advances for the purchase of tenants' holdings.

It may safely be said that no other British statesman has ever been identified with such an imposing roll of important and beneficent legislation. The period covered by Mr. Gladstone's political career embraces a more rapid growth in population and wealth than any corresponding period of the country's history; and with almost all the multitude of reforms which during this time promoted the social wellbeing, healthy growth, and prosperity of the community, Mr. Gladstone has been intimately associated, and has in very many instances been the immediate promoter. He has displayed a combination of qualities and faculties rarely, if ever, before witnessed in statesmanship—financial talent and business aptitude, classical attainments, high moral fervour, and religious spirit. He has thrown round the science of finance a halo with which it seemed impossible to invest it, and has diffused upon great questions a light which brings them clearly within the popular apprehension and understanding; while into every work undertaken by him he has imported an earnestness described as enthusiasm by friends, and as fanaticism by opponents. He began life as the rising hope of the stern and unbending Tories, and in course of time has become the most popular leader of the Liberal party. In a speech at Oxford in 1878 Mr. Gladstone referred to this change in his political views in terms with which the work of his life is perfectly consistent. Alluding to his early education he said, "I must add that I did not learn when at Oxford that which I have learned since—viz. to set a due value on the imperishable and the inestimable principles of human liberty. . . . I think the principle of the Conservative party is jealousy of liberty and of the people, only qualified by fear; but I think the policy of the Liberal party is trust in the people, only qualified by prudence. I am not in the least degree conscious that I have less reverence for antiquity, for the beautiful, and good, and glorious charges that our ancestors have handed down to us as a patrimony to our race, than I had in other days when I held other political opinions. I have learned to set the true value upon human liberty, and in whatever I have changed, there, and there only, has been the explanation of the change."

This same high estimate of the value of human liberty has actuated Mr. Gladstone's dealings with foreign nations as well as with his own countrymen, and the aspirants after civil, religious, and political liberty in every part of the world have ever found in him sincere and enthusiastic sympathy. His withering denunciations of Bourbon tyranny in Naples largely helped to win "Italy for the Italians;" and when the subject nationalities of Turkey groaned under Mussulman persecution, Mr. Gladstone's exposure of the atrocities inspired a strong national feeling throughout this country in favour of "Bulgaria for the Bulgarians."

Probably no minister has ever so completely won the confidence and devotion of the great party by which he was voted into power. Mr. Gladstone's transcendant ability in constructive legislation as well as in finance, his wonderful mastery of details, his powers of exposition and argumentative justification, and the prestige of his vast administrative and parliamentary experience—command the submission of all on his side of the House, of his colleagues, and of the whole Liberal party out of doors. In the force of moral earnestness and in intellectual capacity he is unrivalled. His mind is one of generous impulses, of matchless energy, of broad human sympathies, and of rare intellectual adaptiveness, capable of readily grasping every feature of the varied social conditions of his country.

During the recess of 1883–84 there was a very widespread agitation for an extension of the franchise; so in the following session Mr. Gladstone dealt with the subject in two most important bills—one, the Franchise Bill, to place dwellers in counties on a similar footing with dwellers in boroughs as regards their qualifications as electors; and the other, the Redistribution of Seats Bill, to equalize the numbers of the various constituencies by disfranchising the smaller boroughs and dividing the larger constituencies into single-member wards. After the most stormy scenes the two parties in the House agreed to compromise their differences, and the former bill, which added some 2,000,000 electors to the roll, passed and Parliament was prorogued. When Parliament met in February, 1885, the Redistribution Bill was proceeded with, and became law on 27th May. Almost immediately afterwards the government was defeated on the budget, and Mr. Gladstone resigned, to be succeeded by the Conservatives under Lord Salisbury. The general election of November, 1885, sent 334

Liberals, 250 Conservatives, and 86 Nationalists to Parliament, and when Parliament met Lord Salisbury's administration proceeded with the work of the session, only to be defeated when opposing an amendment to the queen's speech; so in February, 1886, Mr. Gladstone, then in his seventy-seventh year, was once more called on to form a Liberal ministry.

Even when away from the turmoil of parliamentary life Mr. Gladstone has no idea of the rest supposed to be found in an absence of occupation. He is a discursive theologian and commentator on ecclesiastical history; he takes part in the services of Hawarden Parish Church, of which his son is the rector; he cuts down trees like any woodman in Hawarden Park, his residence near Chester, and manages to put into his leisure time, while approaching octogenarian years, as much work as would count for a life of arduous labour in the case of most ordinary men.

GLAMOR'GAN, a county of South Wales, bounded N. by Brecknock and Carmarthen, E. by Monmouth, and S. and W. by the Bristol Channel. It is irregular in form: the greatest length being 52 or 53 miles, and the greatest breadth 27 miles. The area is 547,070 acres. The population in 1881 was 511,433; in 1851 it was only 231,849; and in 1801 only 70,879.

Coast-line, Islands, &c.—The line of Glamorgan coast, from the mouth of the Rumney, where it adjoins Monmouthshire, to Penarth Harbour, is marshy. High cliffs bound the greater part of the coast from Penarth Point to Sker Point. Between Lavernock and Breaksea Points are Sully Island and Barry Island, both small. Barry Island, the larger of the two, is joined to the mainland by an isthmus or causeway dry at low water; it is nearly surrounded by cliffs. From Sker Point to the Mumbles the line of coast forms Swansea Bay. The coast is comparatively low, and skirted by broad sands, dry at low water. At the Mumbles, which are small rocky islets just off shore, the limestone cliffs recommence; and thence to the boundary of Carmarthen the coast forms the several bays and headlands of Worms Head, Caswell Bay, Oxwich Bay, Port-y-nau Bay, Pwlldu Head, Oxwich Point, Port-y-nan Point, Rossilly Bay, the peninsula of Gower, and Whitford Point. There are also a few small islets.

Surface and Hydrography.—Glamorgan is covered with mountains which branch out in every direction, and the highest of which is Llangeinor, 1859 feet.

The general course of the streams is from north to south. The larger streams have their sources in the highlands of Carmarthen and Brecknock, all within a distance of less than 30 miles of each other, but they diverge as they flow towards the coast. The smaller streams rise in Glamorgan itself, and flow either into the larger ones or into the sea. The chief rivers are the Rumney, 30 miles; the Taff, 38 miles; the Daw or Ddaw, 12 miles; the Ogmore, 18 miles; the Avon, 15 miles; the Neath, 23 miles; the Tawe, 26 miles; the Loughor, 14 miles; and the Cynon, 12 miles.

Glamorgan has long been famous for the beauty of its valleys. The vales of Glamorgan, Neath, and Swansea present various forms of fine scenery. In the vale of Glamorgan the climate is so mild that myrtles and other plants requiring a warm climate flourish in the open air. There are several canals in the county, and it is admirably supplied with railway accommodation. Steam-vessels ply regularly from Cardiff and Swansea to Bristol, Liverpool, Ilfracombe, Milford, Hayle, Padstow, Belfast, and Cork.

Geology and Agriculture.—Most of Glamorgan is occupied by the South Wales coal basin, in which blast and anthracite coal (much of which is specially suitable for steam-engines), iron, and ironstone are worked, giving employment to 45,000 or 50,000 hands. It is owing to this great source of wealth that the county has made such wonderful strides during the present century. According to the official mineral statistics published in 1883, there are altogether about 300 coal-mines at work in the county. The quantity of coal obtained in Glamorganshire is 16,000,000 tons per annum. The quantity annually shipped from the ports of Cardiff, Swansea, Neath, and Port Talbot is about 11,000,000 tons—3,000,000 tons coastwise and 8,000,000 tons to foreign countries. The quantity of iron ore raised is about 300,000 tons per annum. There are some large limestone quarries, and tin and copper ores are brought from Cornwall to be smelted at Swansea, Neath, Trefforest, Aberavon, and other places. In those parts of the county not occupied by the mines agriculture is successfully pursued, the proximity of the mining districts affording a certain means of quickly disposing of all kinds of produce; but although great improvements have been introduced within the last twenty years, farming is not yet so well conducted as in many English counties. The Vale of Glamorgan is a level, fruitful tract, 10 miles broad, lying along the sea-coast, on beds of lias, limestone, millstone grit, and old red sandstone, with a rich loamy soil, varied by beds of clay. It produces, on an average, 25 bushels of wheat, 30 to 35 of barley, and 35 of oats per acre; also potatoes, pease, beans, turnips, and mangel wurzel. Farms are of all sizes, and chiefly at a rent of the full annual value or rack-rent. Under the provisions of the Inclosure Acts great portions of the country have been and are still being reclaimed. According to the official agricultural statistics published in 1884 there are 275,000 acres, or rather more than half the entire area, under cultivation. Corn is grown on 35,000 acres, green crops on 15,000, clover, &c. on 23,000, and 200,000 are in permanent pasture. The number of cattle in the county is 50,000, and of sheep 250,000. The stock is generally similar to that of the neighbouring counties, the old native breeds of both cattle and sheep being now almost extinct or amalgamated with other varieties; and of late years very much attention has been paid to both dairy and sheep farming. The industrial establishments of Glamorgan consist chiefly of immense iron and smelting works, iron shipbuilding at Cardiff, tin-plate works at Aberdare, and copper smelting at Swansea. There are also large manufactories of patent fuel.

Divisions and Towns.—Glamorgan is divided into ten hundreds and 131 parishes. Cardiff is the capital town of the county. It is in the South Wales circuit, and it constitutes parts of the dioceses of Llandaff and St. David's. Since 1868 Glamorgan has returned six members to Parliament, two each for the shire and Merthyr Tydvil, and one each for Swansea and Cardiff. The number of county electors in 1884 was 13,200.

History, Antiquities, &c.—Glamorgan was originally included in the territory of the Silures. Under the Roman dominion it was included in Britannia Secunda. Roman roads, camps, and stations have been met with in the county. A native prince gave to the district his own name, Morgan, whence the modern appellation. About the close of the eleventh century the county fell into the hands of the Anglo-Norman barons. Fitzhamon, afterwards Earl of Gloucester, then obtained possession of it; and though subject to many revolts, arising out of the refusal of the Welsh to succumb to feudal customs, his family retained it for many generations.

In the troubled reign of Edward II. considerable lands in Glamorgan were granted to his favourite, the younger Despenser, and the county became the scene of violence and confusion—the barons, confederated against the court, ravaging these lands, and at length driving Despenser into banishment in 1321. On the return of the Despensers from banishment, the younger not only obtained the restoration of his Glamorgan estates, but their augmentation by new grants. In the chequered course of the next two centuries the possession of this district passed from

hand to hand; but an end was put to this state of things in the time of Henry VIII.: the territory of Glamorgan was formed into a county, and the manors of the former lords of Glamorgan, as well as the subordinate lordships, passed into other hands.

Of the middle ages Glamorgan contains many memorials in its ruined castles and monastic remains. Besides the castles of Cardiff, Caerphilly, Neath, and Swansea, there are several others. There are also some good specimens of cromlechs in various parts of the county. Llantwit Major abounds with interest to the antiquarian. It was the seat of the famous theological school founded by St. Germanus and long presided over by St. Iltyd. In the peninsula of Gower, west of Swansea, there are bone caves. There are, in addition to those mentioned above, castles at Ogmore, Oystermouth, St. Donatt's, Marcross, Oxwich, Bewper, Penmark, and Fonmon.

Of the ecclesiastical remains the most conspicuous is Margam Abbey, between the Ogmore and the Avon, south-east of Neath. Of the chapter-house, a beautiful polygon of about 50 feet diameter, the walls remain. Part of the abbey church, which is of Norman architecture, with semi-circular arches, has been kept in repair, and is used as the parish church. There are also ruins in existence of the nunnery of Eglwys Nynydd, the priory of Ewenny, the college of Llantwit, and the abbey of Neath. In the great civil war between Charles I. and the Parliament a severe battle was fought in this county, in which the royalists under Colonel Power were defeated.

The south-western extremity of Glamorgan forms a peninsula called Gower, originally Gwyr, signifying "crooked," or the "crooked county," in which a colony of Flemings settled in the reign of Henry I. These people have preserved many of their own customs and much of their own language, so that here Welsh is rarely heard. In the frontier parish of Llanrhydian the distinction is curiously illustrated, the people being Welsh in one portion of it and of foreign extraction in the other, with little intercourse existing between them.

GLAND. Under this term are included a considerable number of organs in the animal body, which, resembling each other only in a general roundness of form and a firm fleshy substance, possess the most varied internal structure, and perform very different functions. They may be divided into three classes.

1. *Absorbent Glands.*—These form part of the absorbent system. The *lymphatic glands* are masses of various size, but never large, of a roundish form, consisting of congeries of ramified absorbent vessels, frequently communicating with each other, connected by fine, dense, cellular tissue in which bloodvessels are freely distributed, and at intervals dilated so as to give an appearance, when divided, as if a collection of small cells had been cut into. Almost all the lymphatics and lacteals pass through such glands at some part of their course. It is considered by the best physiologists (including Professor Michael Foster), though the point is not definitely settled, that these glands are the place of origin of the white corpuscles of the blood.

2. *Secreting Glands.*—These are organs of different forms and sizes, whose office it is to separate the various secretory and excretory fluids from the blood. The simplest form of secreting gland is that called a crypt, consisting merely of a pit or depression in the surface of some secreting membrane, as the mucous lining of the intestines or the skin. When this depression is deeper, and assumes a cylindrical form, it is called a tubule; and when its closed extremity is dilated so as to give it the form of a flask, a follicle. In various forms and sizes these simple structures are found in great numbers in all animals, as in the sebaceous follicles by which the oily matter is secreted to lubricate the skin, in the intestinal and gastric glands, secreting digestive fluids, &c. In larger size they occur around the pylorus of many fish, forming worm-shaped appendages, and in different parts of the intestines of insects. Sometimes a number of little follicles are congregated together into one mass, opening on the surface, each by a separate orifice or by one common duct, around which they are arranged: the former structure is found in the tonsils, &c.; the latter in the Meibomian glands in the eyelids.

Far more complicated forms are produced when each duct divides into numerous ramifications, each of which terminates in a cul-de-sac, or bears little follicles at its extremity and along its branches. The mammary glands, secreting milk, are fine examples of this variety. They all consist of simple or ramified ducts, communicating at one extremity by open orifices with the external air, directly on the surface of the skin, or indirectly on the surface of one of the open cavities of the body, as the lungs, intestines, &c., and terminated at the other by a cul-de-sac.

3. *Vascular Glands.*—These are masses consisting of a congeries of arteries and veins, but without any duct opening externally. They include the placenta, renal capsules, spleen, and the thymus and thyroid glands. Their structure closely resembles both that of Peyer's glands of the intestine and that of lymphatic glands. Their function is evidently secretion, but they differ from the ordinary secreting glands in their secretion being added at once to the blood without being discharged from the gland, as in the digestive glands, the bile glands, sweat glands, &c. They serve to elaborate the blood, as the lympathic glands elaborate the lymph, and most of them are consequently relatively much larger in childhood than in maturity. It is thought that the corpuscles of the blood which are worn out are removed by the spleen, and it is also believed that the spleen, which becomes turgescent after a meal, serves as a sort of overflow reservoir to the portal system, relieving it from the strain upon it after digestion.

GLAND, in botany, is a term applied to single cells or groups of cells which are distinguished from the surrounding tissue by containing oily, resinous, odoriferous, strong-tasting substances, or such matters, that cannot be used by the plant for purposes of nutrition. Glands were probably in their origin always of an excretory nature, though they are internal as well as external; for instance, nectaries are considered by Darwin to have originated in this way. Glands may be either superficial or internal, that is, lying in the interior of the tissue. The leaves of the camphor tree contain simple internal glands filled with oil of camphor. The glands in the rind of the orange, containing oil of citron, are internal and compound. They are formed by the cell-walls of a group of cells becoming liquid, thus leaving a spherical space filled with mucilage and drops of essential oil suspended in it. The layers of cells surrounding the gland form a distinct envelope, marking it off from the surrounding tissue.

Nectaries, for instance those of the crown imperial, are good examples of superficial glands. Hairs often become glandular, and to this cause is due the viscid character of many leaves and stems. An interesting example of glandular hairs is in the sundew (Drosera) of marshy places, well known as an insectivorous plant. Leaf-buds are often protected from moisture by the glandular character of the scales.

GLAN'DERS (Fr. *farcin*), one of the most malignant and loathsome diseases to which the horse and ass are liable. It affects the blood, the lymph, the lymphatic vessels, the bloodvessels, the cellular tissue, the skin, and the mucous membranes; and is caused in young horses by damp and ill-ventilated stables, overwork, and an excess of stimulating food. When it occurs in old horses it is properly named farcy, which indeed is an aggravated form of the disease, resulting from bad lodging, overwork, and insufficient food. The following is a very accurate statement of the symptoms:

staring coat; lungs or air passages always affected; glands swollen; spirit low; appetite bad; a lymphatic gland adheres to the inside of the jaw; the membrane inside the nose ulcerates; a slight discharge from one nostril; this becomes thicker, and adheres to the margin of the nostril, exhibiting white threads and bits of mucus; then it changes to a full stream of foul pus; next, the nasal membrane grows dull and dropsical, the margins of the nostrils enlarge; the horse breathes with difficulty; the discharge turns discoloured and abhorrent, farcy breaks forth, and the animal dies of suffocation.

Farcy.—It is at first inflammation of the superficial absorbents. Lumps appear on various parts. If these lumps are opened healthy matter is released; but the place soon becomes a foul ulcer, from which bunches of fungoid granulations sprout. From the lumps may be traced little cords leading to other swellings. The appetite fails, or else it is voracious. Matter may be squeezed through the skin. Thirst is torturing. At length glanders breaks forth.

The disease in both forms is highly contagious, both as regards horses and men. Even a very small portion of the pus discharged from the nose of the glandered horse, if it touch the broken skin of man, will communicate this terrible disease. Many deaths have occurred from this. Mild forms of the disease may be cured by careful treatment, but the severer forms are almost invariably fatal.

GLAN'VILLE, a name by which the most ancient treatise on the laws and customs of the realm of England is known. It is generally supposed to be the work of Ranulphus de Glanville, who was the chief justiciary in the reign of King Henry II., and who died at the siege of Acre in 1190, when in attendance on Richard of the Lion heart; but the titles to some of the best manuscripts only set forth that it was written in his time. Earlier than this it cannot be, for among the exemplifications of law-processes are some which took place in court before this Ranulphus (or Ralph). He declines to leave these practical points for theoretical discussions, for the most part, on account of the confusion in which law then was. The work is in Latin.

GLA'RUS, a canton of the Swiss confederation, is bounded N. by St. Gall, E. and S. by the Grisons, and W. by Schwyz and Uri. The greatest length is about 32 miles, the greatest breadth about 16. The area is about 269 square miles, of which one-fifth is arable land. It consists mainly of the great valley of the Linth, which river crosses it from south to north, and of the Sernfthal, or valley of the Sernft, which is an affluent of the Linth. There are also small valleys which open into the two principal ones. It is divided on the south from the valley of the Upper Rhine in the Grisons by a chain of lofty Alps, an offset of which running northwards divides the waters of the Linth from those which flow into the Reuss through the valleys of Uri and Schwyz. To this offset belongs the high and extensive group called Glärnisch, 9000 feet above the sea and covered with perpetual snow, which extends into the canton of Glarus, and rears its head above the town of that name. Glarus was formerly chiefly a pastoral country, but it now has extensive manufactories of printed cottons, muslins, silks, and paper, and exports a large quantity of the green cheese called Schabzjger, for which the canton has long been celebrated. The peculiar flavour, smell, and appearance of this cheese are said to be owing to the cows feeding on the blue pansy or *Trifolium melilotus cærulea.* It imports corn, wine, salt, and colonial produce. The population of Glarus is 34,213, of whom 7000 are Catholics, and the remainder nearly all Calvinists.

The constitution is purely democratic. The government is in the hands of the whole body of the male population above eighteen years of age, who meet usually on the first Sunday in May in a general assembly to appoint the executive and to accept or reject laws proposed to them by the cantonal council. As early as the fifth century the territory of Glarus belonged principally to the abbey of Seckingen on the Rhine; but it fell in the thirteenth century into the possession of the house of Austria. In 1351 it was occupied by the troops of the confederated Swiss cantons, and soon afterwards joined the confederacy, its independence being consolidated by the memorable battle of Naefels, in 1388. After the Reformation it was the seat of continual religious wars, and in 1799 was the theatre of a contest between the Austrians and Russians and the French. The historian Tschudi was a na've of this canton.

GLARUS, the capital of the above canton, is a bustling and cheerful town, in a narrow part of the valley, on the left bank of the Linth. It contains about 5000 inhabitants, and has manufactories of printed cottons and woollen cloth, some iron-works, and a number of mills. The parish church, an old Gothic building, is used for the service of both Roman Catholics and Protestants. Zwingli was for ten years pastor of Glarus. The other remarkable buildings are the town-house, the hospital, and the free school. Glarus was almost entirely destroyed by fire in 1861, but with the help of the government and contributions from all directions it was rapidly rebuilt in a regular and substantial manner.

GLAS'GOW, a city, parliamentary burgh, and port of Scotland, in the lower ward of Lanarkshire, on the Clyde, which divides it into two parts, the largest portion being on the north. It is the chief city of Scotland as respects extent and wealth, and is distinguished as one of the first provincial cities in the United Kingdom in point of population, the following being the census figures for 1881:—

London,	3,816,483
Liverpool,	552,508
Glasgow,	510,816
Birmingham,	400,774
Manchester,	341,414

The following figures show the increase in the population of Glasgow since the commencement of the present century:—

Year.	Population.	Increase in Ten Years.	Total Increase per cent. in each Decennary.	Average Annual Increase ℔ ct. in each Decennary.
1801	77,385	—	—	—
1811	100,749	23,364	30·1919	3·0191
1821	147,043	46,294	45·9498	4·5949
1831	202,426	55,383	37·6645	3·7664
1841	255,650	53,224	26·2931	2·6293
1851	329,096	73,446	28·7291	2·8729
1861	395,503	66,407	20·1786	2·0178
1871	477,732	82,229	20·790	2·0790
1881	510,816	33,084	6·9252	·6925

The numbers for 1881 include a population of about 19,000 resident then in the territory which was added by statute at the 1st January, 1875; as well as a trivial area, containing in all twenty-five electors, which was annexed by the Glasgow Municipal Act, 1878.

There has also been a very large increase in the suburbs immediately contiguous to the city. In 1871 the population of these districts was only 101,930, while in 1881 it had increased to 193,620. In 1871 the population of the city and suburbs was 593,554; in 1881 it had increased to 704,436, or an increase for the ten years of 100,882.

Not only has Glasgow become one of the first provincial cities of the kingdom as regards population, but it may be said to combine the specialties of several large towns—

and to resemble Liverpool in its shipping, Manchester in its cotton manufactures, Newcastle in its coal trade and iron shipbuilding, and Merthyr and Wolverhampton in its iron furnaces; while the industry and perseverance of its inhabitants have converted the shallow Clyde into a broad and deep waterway, suitable for the largest vessels.

Although the situation of Glasgow appears flat and monotonous as compared with the romantic position of Edinburgh, it is in reality very advantageously, and to a certain extent picturesquely situated on either bank of the Clyde; the southern districts of Gorbals, Hutchesontown, and Tradeston bearing the same relation to the city as Southwark does to London. The northern portion is much steeper, and stretching away to the west, at a few miles' distance, are ranges of hills forming a good background. As a result of the incessant industrial activity, the city suffers from an atmosphere almost always, even in summer, tainted with smoke; and in the hottest months of the year a large number of the citizens migrate to the numerous marine villages on the Clyde, the ready access to which is a convenience that few places possess in so great a degree.

Glasgow is situated in 55° 53′ N. lat., and 4° 18′ W. lon. It is $47\frac{1}{2}$ miles from Edinburgh, and $405\frac{1}{2}$ from London. The length of the city from east to west is about 5 miles, and its average width about 3 miles. It is said that the Romans had a station on the site now occupied by the city; but it owes its origin to the small church or cell established here in the sixth century by St. Kentigern, or St. Mungo (Munelm), a contemporary and friend of Columba. In 1175 William the Lion granted to Joceline, who then filled the see, a charter authorizing him "to have a burgh at Glasgow." In 1190 the same prelate obtained a charter establishing a fair. In 1450 James II. granted to Bishop Turnbull a charter erecting the city into a burgh of regality. All this time the citizens were the mere vassals of the bishops, and the full power of electing the provost and other magistrates—which had previously been exercised by the bishops—was by a charter of James III., in 1470, confirmed to Bishop Laing and his successors. In 1491 Glasgow was advanced to the dignity of an archbishopric by a bull in favour of Bishop Blackadder, who at the same time obtained from the king an extension of the rights and privileges of the see. It was not till after the Reformation that Glasgow was created a royal burgh, by a charter of Charles I. in 1636; but even then the right of appointing the provost and magistrates was reserved to the Protestant archbishops, and afterwards that power was exercised by the barons who had obtained gifts of the temporalities. It was only by a charter of William and Mary that the city and council acquired the right to choose their own magistrates, and not till then can Glasgow be said to have acquired an independent political existence. By the Municipal Reform Act the citizens are empowered to elect the town councillors, of whom there are three returned by each of the sixteen wards into which the city is divided; one by the Merchant's House, who is dean of guild; and one by the Trades' House, who is deacon-convener—thus making fifty in all, who constitute the town council, which elects from its members a chief magistrate and ten bailies. The chief magistrate, whose official title is *lord provost*, is justice of the peace for both the burgh and the neighbouring counties. He holds his office during three years, and is eligible for re-election. The bailies exercise a jurisdiction in cases of crime and misdemeanours committed within the burgh not touching the life of the offender, and are *ex-officio* justices of the peace for the county. The parliamentary burgh returns three members, one having been added by the Reform Act of 1868. In 1884–85 the number of electors in the parliamentary burgh was 70,657, and in the municipal burgh, 88,718—14,592 of the latter being females.

Most of the leading streets run from east to west, parallel to the river, and as they are generally crossed at right angles, Glasgow forms a very regularly built city; the majority of the streets are very wide, and the houses and squares have an elegant appearance. The houses are generally lofty and built of freestone, the floors of each tenement being very commonly occupied by separate families, entered by a common stair. Its public buildings are in general handsome, and in most cases are so disposed as to be seen to the best advantage. The cathedral, dedicated to St. Kentigern, stands on high ground on the north-east of the city, and is considered the most perfect specimen of Gothic ecclesiastical architecture remaining in Scotland, and is, with the exception of Kirkwall cathedral, the only Scottish structure of the kind left uninjured at the time of the Reformation. It was commenced in 1123 by John Achaius, bishop of Glasgow; rebuilt in 1197, and completed about the middle of the fifteenth century. Its length is 319 feet, and the height of tower and spire 225 feet. It was renovated and restored some years since by government, and the progress of the restoration suggested to certain citizens the happy idea of embellishing the noble building with memorial windows of stained glass by means of individual gifts. The idea was thrown out in 1856, and the task was completed in 1864. With the exception of the windows of the chapter-house and crypt, the whole were executed at the royal manufactory at Munich, and form a connected and consecutive series. The choir is used as the place of worship. The churches of St. John, St. George, St. David, St. Andrew, St. Enoch, and most of the recently built Established, Free, Episcopalian, and other churches, are also fine buildings. There are upwards of 300 places of public worship—the churches of the Establishment, of the Free Church, and of the United Presbyterians exhibiting pretty equal proportions, while every other Christian denomination is represented. The other public buildings which merit particular mention are—the University Buildings, Merchants' House, Post Office, Anderson's College, Royal and Western Infirmaries, St. Andrew's Public Halls, City and County Buildings, Royal Exchange, Stock Exchange, Corn Exchange, the various banks and insurance offices, the Procurators' Hall, Parochial Buildings, Institution for the Deaf and Dumb, Asylum for the Blind, Royal Lunatic Asylum at Gartnavel; South Prison, now court-houses; the North Prison, and a new prison at Barlinnie, to the north-east of the city. The Green of Glasgow is a large park, stretching along the north bank of the river, comprising upwards of 130 acres, and being about 2 miles in circumference, with the Nelson column, about 143 feet high, in its midst. Kelvingrove Park, situated on both sides of the Kelvin, at the west-end, was partly laid out by the late Sir Joseph Paxton, and contains the City Industrial Museum, a handsome fountain erected in 1872 in memory of Lord Provost Stewart, who promoted the introduction of the water supply from Loch Katrine. Queen's Park, on the south of the city, inclosing about 120 acres, is exquisitely laid out, and commands many splendid views. There is likewise the Alexandra Park, about 74 acres in extent, in the north-east of the city.

Glasgow contains equestrian statues of her Majesty, of the Prince Consort, of the Duke of Wellington (all three executed by Baron Marochetti), and of William III. There are also public statues of John Knox, Sir John Moore, Lord Clyde, Watt, Scott, Burns, Campbell, Livingstone, Peel, Lumsden, Oswald, Pitt, Professor Graham, Graham Gilbert, and Norman Macleod. In 1883 the foundation stone was laid in George Square of new municipal buildings, which will cost £250,000 and cover an area of 656 square yards. The site was formerly covered with business premises, and in acquiring the ground the corporation expended about £172,500. The principal frontage, on the east side of George Square, will have a general elevation of 75 feet, with cupolas, to a height of

125 feet, crowning the loftier part of the edifice; the style is Italian Renaissance, with noble windows of Venetian character set between coupled Corinthian columns, and with square turrets and cupolas. The building will contain a grand banqueting hall, council chamber, town clerk's offices, and those of the city chamberlain, and of the departments of finance, lands, gas, water, and public works.

The city is admirably lighted and paved, and a system of street tramways was introduced in 1874. Formerly the inhabitants were dependent on the Clyde for their water supply, but they now obtain it from the purer source of Loch Katrine, from which it is conveyed by costly works through the intervening 35 miles of rugged country. The works, which cost £930,000, were opened by Her Majesty in 1859. The daily supply from that source is above 30,000,000 gallons of the finest water in the world, and a further supply of about 4,000,000 gallons is obtained by gravitation from the hills to the south of the city. It is in contemplation to undertake the construction of a second aqueduct and storage reservoir, by means of which the supply will be nearly doubled.

The city of Glasgow set a good example in providing better homes for the humbler classes. Formerly a large number of the population were crowded together in pent-up closes of about 3 and 4 feet wide, with large tenements of three and four storeys rising on each side, and running backwards to the extent of 250 feet, in some cases even to 280 feet, so that neither the light nor the air of heaven could freely penetrate. A large portion of the dwellings were dark, dismal, unwholesome, and devoid of comfort and family accommodation, and when fever or contagious disease broke out the results were often appalling. To remedy this state of things measures were adopted by the corporation, and an Act of Parliament, now widely known as the Glasgow Improvement Act, was obtained for a bold and comprehensive scheme. Under its operation whole streets of unwholesome houses have been swept away in order to obtain breathing spaces, and broad spacious streets have been formed in their stead, about 100,000 square yards of ground having thus been added to the street surface of the city. From 1867 to 1881 about £1,700,000 had been expended in the purchase of property, and about 42,000 dwellings, giving accommodation for 210,000 persons, have been provided by private enterprise within the municipality; while within a radius of half a mile of the city there has been provided accommodation for another 100,000 persons. The city improvement trustees made provision for the displaced householders by laying out for building, on a liberal and airy plan, two suburban estates, which were almost immediately covered by improved modern dwellings. They also erected, under the terms of the Improvement Act, two tenements of model houses in Drygate, and seven lodging-houses in different situations for the accommodation of the humbler class of artisans. The effect of these changes on the health of the inhabitants, and more particularly on that of the children, has been very striking.

There are seven bridges over the Clyde. Two are of granite, 60 feet wide, and of light and elegant appearance, the lowest, or Glasgow bridge, having been designed by Telford; a third is an elegant structure of iron and granite; two are suspension bridges, of a single span, for foot passengers; and the river is also crossed by two iron railway bridges. Below the bridges there are numerous steam ferry boats plying at all hours, and a frequent service of passenger steamers at low fares from one extremity of the harbour to the other has been provided by the harbour authorities.

Until 1775 the Clyde was only navigable by vessels of very small burden, but since that time above £8,000,000 have been expended in its improvement. The river has been embanked, the bed deepened, and the numerous sandbanks and other obstructions to the navigation have been removed. There are now very extensive and massive quays —extending downwards from Victoria Bridge on each bank to a distance of nearly 2 miles, and vessels drawing 23 feet of water can come up to the city. Sixty years ago its depth under favourable circumstances was *five* feet. The quay on the north bank was formerly, but the whole harbour now is, denominated the Broomielaw. Two important docks, the "Kingston" and the "Queen's," have been added to the equipments of the navigation—the former having a water space of 5½ acres and the latter of 33½ acres. Both are situated within the city boundaries, and the latter was opened in 1877. Another dock has subsequently been commenced on the south side of the river, just opposite the Queen's dock, by which the harbour accommodation will be greatly increased.

Glasgow is connected with the Atlantic by the river Clyde, and communicates with the German Ocean by means of the Forth and Clyde Canal. Prior to the Union in 1707 its commerce was limited to France and Holland, and consisted principally in the curing and exportation of salmon; but after that it entered so extensively into the trade with Virginia and Maryland, that before the commencement of the American War in 1776, which suspended the tobacco trade, the annual imports of that article into the Clyde amounted to about half the entire quantity consumed in Great Britain. In recent years the trade with the United States and the West Indies, and the timber trade with North America, have been carried on upon a very large scale.

The development of the commerce of Glasgow has probably been more rapid than that of any other port in the United Kingdom. In 1656 the customs duties (imposed equally on exported and imported goods) amounted to £554, which was, in fact, a large sum, considering that at that time no larger vessels could come up to the Broomielaw than those carrying from 3 to 6 tons. Port-Glasgow was constituted the head port of the Clyde towards the year 1700, Glasgow and Greenock being deputy or subports thereof till 1812, when each was declared independent. A great change has taken place since that date, as Glasgow has for many years been the port of greatest importance, Greenock next, and Port-Glasgow the least. Ultimately, Port-Glasgow was, in 1875, discontinued as a separate customs port, its business being transferred to Greenock. The trade of Glasgow was greatly cramped prior to 1817, the customs requiring duties to be paid immediately on arrival. In that year the privilege was first conceded to Glasgow of securing goods in warehouse under bond, which had a most important effect both on the trade of the port and on the customs revenue. The latter increased from £11,428 in 1820 to £884,900 in 1883. It has often exceeded £1,000,000 sterling, and the smaller amount in late years arises solely from the abolition of the duties on sugar and other articles.

The number of vessels registered as belonging to Glasgow in 1884 was—

	Vessels.	Tons.
Sailing,	607	411,413
Steam,	772	568,251
	1,379	979,664

The entries in 1883 were 8251 (2,637,437 tons), and the clearances 9345 (2,906,395 tons).

At Glasgow Watt began his improvements on the steam engine, and thence the *Comet*—projected by Henry Bell, of Helensburgh—the first vessel in Europe successfully propelled by steam, was launched in 1812. Steamers now run regularly to Belfast, Bristol, Campbeltown, Cork, Dublin, Inverness, Islay, Liverpool, Londonderry, Oban,

Sternoway, Swansea, Waterford, and many ports of the continents of Europe, America, Africa, and Australia.

Glasgow has a Chamber of Commerce, Merchants' House, Trades' House, West India Association, and numerous other public commercial bodies. It is also the headquarters of the Royal Northern and Clyde Yacht Clubs, and of various rowing and bowling clubs, as well as for football, now become an institution.

The manufacture of linens, cambrics, &c., was first introduced into Glasgow about 1725, the power-loom in 1793; and at the present time the establishments for weaving and spinning cotton are numerous. The manufacture of iron has become annually of greater extent; and from the peculiarly advantageous position of the town in a mineralogical point of view (abundance of coal and ironstone being found in the immediate neighbourhood), it has become the centre of an iron district. Iron and steel shipbuilding is carried on to such an extent that the value of the steamers and sailing ships launched on the Clyde annually has been estimated at over £4,000,000; and machinery of all kinds—especially steam-engines—is produced in very large quantities. There are also extensive woollen, silk, glass, pottery, and chemical manufactories in various parts of the city and neighbourhood. Glasgow was early distinguished for superior letterpress printing. It has now about twenty newspapers, six of which are published daily—three of them being issued in the evening; and it is the centre of a very extensive system of railways, which radiate in every direction.

The University of Glasgow was founded by a bull of Pope Nicholas V., granted in 1450. In 1572 it acquired some church property, and in 1577 James VI. made further additions to the endowments, and granted a charter which is the foundation of its present constitution. The officers of the university consist of a chancellor, vice-chancellor, lord rector, dean of faculties, and principal. It is well endowed, the annual income being about £20,000. Twenty-seven professorships are attached to it, and the number of matriculated students now averages above 2000. They reside outside the college walls. The session begins on the first Tuesday in November, and ends on the 1st of May. The medical school opens a week sooner and closes early in April. There is a summer session of the medical classes from the beginning of May till the end of July. There are several very valuable foundation exhibitions and scholarships, and a great many bursaries, the total annual value of which is £6500. The library was founded in the fifteenth century, and contains an extensive and valuable collection of books and MSS. for the use of students and members of the general council. In July, 1781, the university acquired a splendid collection of coins, medals, pictures, and anatomical preparations, by the bequest of Dr. William Hunter. An observatory, a botanical garden, and a medical hospital are also connected with the university, which has long maintained the position of one of the first medical schools in Europe. The university and college buildings were for upwards of four centuries situated on the east side of the High Street, and formed several quadrangles. The overcrowded state of that quarter of the city compelled the authorities to endeavour to remove the institution to a more suitable locality, and with the promise of a parliamentary grant and large public subscriptions they secured a site at Gilmorehill, a beautiful sloping stretch of ground adjoining the Kelvingrove Park. On 8th October, 1868, the foundation stone of the new buildings was laid by the Prince of Wales, and with the exception of the tower and some minor parts, the buildings were completed in the short space of three years. Occupying a space of nearly 6 acres on the summit of the hill, the buildings, which were designed in the Gothic style by Sir G. Gilbert Scott, have a most imposing appearance. They form a large oblong rectangular pile 534 feet long, with an average breadth of 300 feet. The principal front faces the south, and consists of a centre and two wings, terminating in slightly projecting flanks. The tower, when completed, will rise to a height of 300 feet, or a fourth higher than the old cathedral spire. The Hunterian Museum, formerly situated behind the old college in the High Street, forms part of the new buildings. The grounds around the university have been beautifully laid out. About £500,000 have already been spent on the buildings, including £45,000 presented by the Marquis of Bute for the erection of the Bute Hall. Of these funds £30,000 were devoted to the erection of a public hospital; so that there is now required to complete the edifice only a portion of the great central tower and the west side of the west quadrangle, involving an outlay of probably £60,000. Under the Scotch Reform Act of 1868 the university unites with that of Aberdeen to return one member to Parliament.

Anderson's College, which has lately been greatly enlarged, was founded by Professor John Anderson in 1795, and endowed by him with a library, museum, and philosophical apparatus. It was incorporated the following year, and placed under trustees. The original object of the founder was to provide for the more popular diffusion of scientific knowledge by means of lectures, chiefly upon natural philosophy and chemistry, and the institution has been productive of the happiest results. In recent years the trustees have added a higher class of education, and the institution now includes an eminent medical school with nine professorships and six lectureships. Students attending the lectures are received by all the royal colleges and licensing boards of the United Kingdom. The High School, formerly called the grammar-school of Glasgow, is of remote antiquity, having been founded in the twelfth century, and continued an uninterrupted career as an exclusively classical seminary till 1834, when other branches of education were introduced. It is now under the management of the School Board of Glasgow. There are two normal schools or training colleges for teachers (belonging respectively to the Established and Free churches), an athenæum, and numerous private seminaries of education. The benevolent institutions of Glasgow include two infirmaries, a lunatic asylum, blind asylum, eye infirmary, deaf and dumb institution, Magdalene institution, lying-in hospital, dispensaries for various separate diseases, Hutcheson's hospital, poorshouses, refuges, reformatories, and numerous societies for educational and philanthropic purposes.

Glasgow is pre-eminently a self-supporting city, and owes none of its progress—not even in connection with the enormous outlay upon the river and harbour—to any assistance from government, either imperial or municipal. Curiously enough, although the city has long carried certain armorial bearings, its proper arms were only authoritatively assigned in 1866, when the Lyon King of Arms, by a patent dated 25th October, placed the ancient tree upon the *shield*, and gave a half-length figure of St. Kentigern as the *crest*, with the addition of supporters.

The climate is moist, and notwithstanding the great improvements we have referred to in the dwellings of the working classes, the rate of mortality is still somewhat high.

GLASS is a beautifully transparent substance, extremely brittle, and breaking with a conchoidal fracture. From its fusibility it is easily moulded or blown into a great variety of forms, and it can be drawn out into thin threads which resemble silk, are extremely flexible and tenacious, and can be woven into cloth. It can be made much less brittle by immersing the vessel while red hot in a bath of paraffin oil; this constitutes the "unbreakable" glass. A tumbler treated in this way can be dropped on the floor without breaking. Great care is necessary in annealing glass; much time is given to this, and the cooling is rendered extremely gradual. When a drop of melting glass is

dropped into cold water a pear-shaped globule is produced with a long thin tail. The solid end will bear a considerable blow, but if the end of the tail be nicked off the globule flies to dust. These are called Rupert's drops.

Glass is soluble in alkalies. The silicates of potassium and sodium, under the name of soluble glass, are large articles of commerce, and are used in making artificial stone, in washing the walls of houses, for preserving the stone, in making cements, and in stereochromy and fresco painting. Glass is easily coloured or "stained" by melting metallic oxides with it. The ruby colour is produced by gold, blue is obtained by cobalt, green by iron, and yellow by uranium. Glass can be crystallized by slow cooling. It is easily soluble in hydrofluoric acid.

The following table shows the percentage proportions of the chief components of the ordinary varieties of glass:—

	Crown.	Flint.	Plate.	Bottle.	Crystal.
Silica,	67	44	78	59	56
Potash,	21	12	2	3	9
Soda,	...	...	13	...	...
Lime,	10	...	5	25	3
Alumina,	2	1	2	6	...
Oxide of lead,	...	43	...	...	32
Oxide of iron,	...	...	...	7	...

The economic uses of glass are so numerous and important, and so familiarly known to all, that it is unnecessary to speak of them. The influence which this substance has had on the progress of science is very remarkable. It is chiefly through its aid that astronomy has attained a perfection so wonderful; by means of it also naturalists have been enabled to study under the microscope innumerable phenomena which would otherwise have remained utterly unknown. Of equal if not greater importance is the use made of it by the chemist in his experimental operations; to it is chiefly owing the present advanced state of his science, which has been so fruitful in marvellous applications in the industrial arts.

The origin of glass is uncertain; it dates from a high antiquity. The Egyptians, who made chemistry their study, were acquainted with it 5000 or 6000 years ago. The earliest known representation of glass blowing is in a tomb of the fifth dynasty at Sakkara. Glass vases, if we may trust to the representations in the Theban paintings, are frequently shown to have been used for holding wine, as early as the Exodus, about 1490 years before the Christian era. There is in the British Museum a perfect and beautiful goblet excavated by Mr. Layard from among the ruins of Nineveh. It has a name engraved upon it, and from the characters employed and the locality in which it was found, it is believed to be of a date about seven centuries before Christ, and is probably the oldest piece of glass of large dimensions in existence. The glass of Egypt was generally opaque, rarely transparent, and always coloured, the articles made of it being of small size. Specimens exist of this glass bearing the name of the Egyptian Queen Hatshepu, of the eighteenth dynasty, 1445 B.C.; and vases of blue glass, with wavy lines, and in many other colours, have been discovered in Egypt. After the Egyptians, the people of antiquity most renowned for glass were the Phœnicians, who indeed were the legendary inventors of it. The glass-making art in Italy does not date earlier than the commencement of the Roman Empire, importations from Sidon and Alexandria having previously supplied the want of native manufacture. As early as 58 B.C. the theatre of Scaurus had been decorated with mirrors or glass plates, disposed on the walls. Glass utensils have been found among the ruins of Herculaneum, and there is plenty of ancient glass in the Naples museum, and a sheet of glass still exists in a window frame at Pompeii. Only a little over a century ago the great baths of Pompeii had all their ancient windows complete, as Dutens testifies in 1778. The best account of "Glass in the Ancient World" is that by Mrs. Wallace Dunlop, which is exhaustive and profoundly interesting (London, 1888).

Early in the thirteenth century the Venetians cultivated the art, and from them it extended into Germany and France. Bede asserts that glass was first introduced into England in the year 674. Owing to the able efforts of Dr. Salviati, Venice has again become famous for the manufacture of beautiful glass; so great is the manipulative skill of the Venetian workman, that instead of using cutting instruments as in England, he models his article entirely while the glass is in a state of fusion, and has nothing more to do with it when it has cooled. He never puts the colour on afterwards, but mixes it in the liquid paste; and he has to complete the most elaborate articles in a few minutes—every second being valuable, as the glass would become brittle if allowed to cool rapidly, and if kept too long out of the annealing oven.

The earliest manufacture of flint-glass in England was begun in 1557, and that of plate-glass in 1673. The manufacture was encumbered with an excise duty for more than a century. The principal seat of the manufacture is at Newcastle-upon-Tyne, Shields, Stourbridge, Liverpool, St. Helen's, Bristol, Warrington, Birmingham, Leeds, Glasgow, and London. The art of glass-making was introduced into Scotland in the reign of James VI. An exclusive right to manufacture it for the space of thirty-one years was granted to Lord George Hay in 1618. The first manufactory was carried on in a very rude fashion at Wemyss, in Fife. Regular works were afterwards established in Scotland at various parts of the kingdom, at Prestonpans, Leith, and Dumbarton. The manufacture of crystal ware and of bottles is now carried on in Glasgow. There are several kinds of glass manufactured, of which plate, crown, flint, and bottle glass are the most important.

Plate-glass is usually cast. It requires forty hours' exposure to the full heat of the furnace to reduce the materials to the proper state of fusion and vitrification. When this is accomplished the glass is transferred from the melting-pot to a large vessel called a *cuvette*, and from this to a casting-table, where it is distributed by means of a roller over the whole surface of the table; bars of metal being placed at each side along its entire length and across the bottom, in order to prevent the glass from running upon the floor. The casting of large plates of glass is one of the most beautiful processes in the arts; the large mass of melted glass, rendered in a high degree luminous by heat, exhibits changing colours in the sheet after the roller has been passed over it.

When annealed, which all glass requires to be before using [see ANNEALING], the plates of glass are ground first with powdered flints, then with emery powder, and finally polished with oxide of iron laid upon woollen pads. Two plates are ground together, one upon the other, the upper plate being attached to an iron arm, driven by steam, and which gives an eccentric rotary motion resembling that of the human arm. Plate-glass is silvered for looking-glasses with an amalgam of mercury and tinfoil. A more perfect mirror can be obtained by coating the plate with metallic silver deposited from solution by glucose or some other reducing agent. Plate-glass in its unpolished state, sometimes with designs impressed upon its surface from the table on which it has been poured, is now largely used for sky-lights and other purposes where light is required without transparency. Beautiful designs are also traced upon the plate-glass by coating it with wax, and tracing the pattern on the wax. The design is then "bitten" in by hydrofluoric acid, either in solution or as gas. The pattern is clear when the solution is used and opaque when the gas is employed.

To describe completely the implements employed, and the steps taken in glass-working, would demand more

space than can be afforded for it here. Moreover glass-blowing is exceedingly difficult to describe; the various vessels made appear to grow under the dextrous hands of a skilful workman, and a spectator comes away with a very indefinite idea of how the work is done. Suffice it to say, that *crown-glass* is made by blowing, in the form of circular plates of 50 to 60 inches diameter. A quantity of glass in the pasty state is collected upon the end of a hollow iron tube; and this glass is then converted, by blowing through the tube, into a hollow globe of the requisite substance. This globe is transferred to the end of a rod, and after several reheatings it is twirled round by the workman somewhat in the manner that a mop is twirled to drive off the moisture; with this twirling the softened material is continually driven off from the centre by the centrifugal force, until at length the whole substance is converted into a flat disc of circular form, except at the centre, where it is attached to the rod, which leaves a lump of glass known as the "punty mark."

An improvement on this method is now a good deal adopted for making sheet-glass or patent plate. Instead of a globe the glass is blown into an even cylinder; this is cut with a diamond and laid on a flat iron bed heated to the softening temperature of the glass; the sides of the cylinder are thus opened out and a flat, thin sheet is formed. Crown-glass has a specific gravity of 2·487, and contains potassium and calcium silicates. The composition is $2(K_2O3SiO_2)+3(Ca_2O3SiO_2)$.

Flint-glass was originally made of calcined flint as the silicious ingredient, for which fine white sand is now substituted. Whenever the glass appears fine, and is freed from its air-bubbles, which it usually is in about thirty-six hours, it is ready for working. It is a silicate of potassium and lead, and requires very pure materials. A common mixture is quartz sand 100 parts, pearl-ash 50, oxide of lead 100, borax 3, arsenic 0·15, peroxide of manganese 0·2. It has a specific gravity of 3·5, and contains $2(K_2O2SiO_2)+3(Pb_2O2SiO_2)$. Faraday made a flint-glass of specific gravity 5·44, which contained boric acid.

Bottle-glass is inferior in quality, the alkali employed being the cheapest that can be procured, with the addition of a large portion of lime to assist fusion. Bottle-glass is fashioned by blowing into hollow moulds. This glass has a specific gravity of 2·732. It is very infusible, and consists of silicates of calcium and aluminium, $3(Ca_2O3SiO_2)+AC_4O_3SiO_2$. It also contains iron, to which the green colour is due.

Crystal glass is a silicate of potassium and lead. It is transparent and colourless, and used in the construction of lenses. It contains $2(K_2O4SiO_2)+3(Pb_2O1SiO_2)$. The glass used for the manufacture of artificial gems has more lead; it contains $K_2O2SiO_2+3(Pb_2O2SiO_2)$. Enamel glass is a similar compound, but rendered opaque by stannic oxide.

All these varieties are mixtures of silicates of potassium and sodium with insoluble silicates of calcium, barium, manganese, or lead. The mixtures are fused together at a high temperature in specially constructed earthen pots. The glass-house in which the processes of melting and blowing are performed is usually built in the form of a truncated cone, open at the top, of 60 or 80 feet in height, and 40 or 50 feet in diameter at the base. In the centre of the interior is placed the melting furnace, which is also circular, capable of holding from five to ten glass pots or crucibles for fusing the materials. The grate of the furnace is nearly on a level with the floor of the glass-house, and the ashpit or cave is a subterraneous passage extending from each side of the furnace to the exterior of the building. Improved furnaces on a system invented by Siemens are now largely employed, in which there is substituted for the several pots one tank divided so that as the batch or ingredients reach the different stages of fluidity the melting mass passes into compartments kept at suitable temperatures. These furnaces are heated by gas from a producer on the Siemens regenerative principle. A very high and easily regulated temperature is obtained, combined with great cleanliness, a most important advantage in working glass. These furnaces are much used in the manufacture of plate-glass.

The preparation of the melting pots is one of the most essential particulars in this manufacture. These vessels are composed of clay, which requires to be as free as possible from lime and iron. The neighbourhood of Stourbridge affords the most esteemed variety of this raw material. The clay is mixed with varying proportions of the ground remains of the old pots, and the tempering or previous preparation of the mixture requires great attention. By careful kneading the mass is rendered very free from particles of air. The bottom of the pot is first moulded on a board, and when this part is finished the sides are then built up, an operation which is done slowly and by well-united layers. The pots used for bottle, crown, and plate glass have the form of an inverted truncated cone. Those for flint-glass are hooded or covered at the top. The great amount of labour bestowed on these pots makes them very expensive, their value being from £6 to £10 each. They are annealed before they are removed to the main furnace, and the latter operation involves a great deal of labour and attention. The opening by which the pots are introduced into the furnace is closed with a door built of fire-brick, and covered with fire-clay to prevent the escape of heat. The [illegible]ots [illegible] filled with th[illegible] [illegible]ared [illegible]als [illegible] closed by a horseshoe-shaped piece of baked fire-clay, and the heat is raised gradually and increased for ten or twelve hours. The melted material throws up a scum, which is removed, and what remains is called the *metal*, which is ready for the operation of the workman, technically called the *journey*.

GLASS INCLOSURES occur in many minerals, in vitreous rocks. They are portions of the original magma, caught up in the mineral when crystallizing out; they vary greatly in shape, but sometimes assume definite crystallographic forms, and frequently contain a fixed bubble.

GLASS PAINTING. The art of colouring glass has been employed for ornamental purposes from very early times, but it is during the Christian era that, used in conjunction with Gothic architecture in the decoration of ecclesiastical buildings, it has attained its greatest perfection. Its effect in tempering and richly colouring the light as the latter entered through the graved windows, rendered it peculiarly adapted for filling up and relieving the rich tracery of mediæval architecture. There are four methods employed for producing the glass to be used in painted windows. In the first the colouring material, which is generally some metallic oxide, is mixed with the other ingredients of the glass before they are placed in the furnace, so as to produce a transparent glass of the same tint throughout. This is called "pot metal." The second method is that in which only a thin film of pot metal is attached to the surface of clear colourless glass. This coated glass is known as "flashed glass." In the third method suitable colours are laid on in the form of paint, and then burnt in so as to leave a stain. In the fourth and last method opaque or semi-opaque enamel colours are attached by heat. A peculiar richness, which is observable in ancient glass, has been discovered to be merely owing to the action of the weather pitting the surface with minute pores, and so decreasing the glare of the glass; but there are now several ways of producing the result artificially, one of which is to scatter sand over the surface while it is soft and uncoloured. The habit in the early times of Christianity of rousing devotion and conveying teaching to the ignorant by means of pictures found a valuable aid in the bright and brilliant paintings rendered possible by the

art of glass painting, and artists employed themselves in portraying saints and drawing scriptural pictures in mosaics, in which the glass, prepared by the methods previously described, united by lead, combined to produce a beautiful effect.

Church windows have been decorated in this way as far back as the ninth, or according to some authorities, as early as the fifth century. The most flourishing period of the art is generally considered to have extended from the thirteenth to the fifteenth century; after that a decline set in, which ultimately reached such a point that not only did the artistic power of executing works of this nature seem to die out, but most of the processes themselves were lost, and it was only at the beginning of the present century that by the aid of chemical knowledge and microscopic examination glass painting revived. Though improvements in staining glass have enabled large and effective paintings to be made in one piece, yet the ancient mosaic form is still generally used. Each window consists of a number of pieces of differently coloured glass, united by grooved lead, a dark brown pigment being employed to define the more delicate and minute details. To produce the effect of the design various shades of glass are laid on the original drawing, and cut bit by bit to the required size, after which details of features, drapery folds, &c., are marked; these are then burnt in in a kiln. The pieces are then fitted into their lead frame, and the whole picture rendered firm and water-tight by a kind of cement poured over the surface. Modern designs are still chiefly founded on those produced by the artists of the middle ages, of which very often they are little more than servile copies. It is customary to divide the works of these originals, especially with regard to England, into several epochs, according to the peculiarities that generally characterize them.

The first is the Early English, commencing approximately towards the close of the twelfth and extending to the end of the thirteenth century. The windows of this period are characterized by extreme simplicity and even crudeness of design; but these defects, as such, when carried to extremes, are counterbalanced by the great richness of general effect, and an apparently intuitive appreciation of the rules which affect and govern a pleasing harmony of colour.

By slow degrees the style became merged into what is known as the Decorated or second pointed period, which is considered to close about the end of the fourteenth century. This epoch appears in mediæval art to be the culminating point in architecture, stained glass, and illumination, beyond which the most aspiring ambition could not hope to pass. The windows now begin to be divided by mullions, and as the years went on, the mullions, by interlacing curves, formed smaller openings in the upper part of the window, called tracery. An increase in the power of expression by painting also led to the cutting of the glass in larger pieces, and this, of course, implies a more sparing use of the lead-grooves, and a corresponding increase of lightness.

The third period, called the Perpendicular or third pointed, followed, and with it the decline that was to end in the almost total destruction of the art commenced. Arising, no doubt, from an honest desire of the artists of this period to outstrip those of preceding times, brilliant and gorgeous colours were discarded, and the pictures presented little positive colour, except in the backgrounds to figures or subjects; for the magnificent canopies of the Decorated period elaborate and generally painfully top-heavy structures were substituted, certainly more true in insignificant details than their predecessors, but in disregard of the commonest rules of perspective.

Glass-mosaic has in modern times been successfully revived in Venice by the efforts of Dr. Salviati, who has succeeded in producing in glass from the seven colours of the rainbow 22,000 shades of colour, of which 200 are flesh-tints alone, and a beautiful gold background by fusing a thin plate of gold between two plates of glass. The modern mosaic-worker lays his cartoon or working-drawing on a table, face upwards. By means of a sharp hammer and anvil he divides his pancakes of coloured glass into small dice, measuring a centimetre—a little over one-third of an inch—each way, and then places them on the picture, matching each tint and shade with the utmost exactness. When the design is entirely covered he pours over it a fine cement, which penetrates every crack, and unites the whole into one solid mass. It is then placed in a shallow zinc tray; the design is washed off and the picture appears, a true copy of the original, but with greater warmth of colour.

GLASS TISSUE (the *tissu de verre* of the French) is a very ingenious method of incorporating with silk, or other fibrous materials, the hair-like filaments of glass, which are drawn out by means of the blowpipe. The production of these glassy filaments is one of the prettiest of modern arts. Nothing can exceed their lustrous beauty, when grouped side by side. The inventive faculties have been directed to the art of combining these filaments with textile fabrics, especially silk, and the result has been the production of a very beautiful article, called "glass-tissue," consisting of a woven mixture of silk and glass.

GLASS'ITES, a religious sect founded in Scotland about 1730 by the Rev. John Glas, a minister of the Scotch Church, whose leading idea was that all national establishments of religion are inconsistent with the true nature of the Church of Christ. A follower of Glas, named Robert Sandeman, spread his views in England, and their disciples are there called Sandemanians. They have decreased during the present century, and their numbers are now very small indeed. The Glassites do not join in prayer with those who are not brethren in Christ or eat blood or things strangled, and have love-feasts or dinners between morning and afternoon services, at which every member must be present. Their charity both to their own and other poor is very commendable.

GLASS-SNAIL (*Vitrina pellucida*) is a species of land snails (Helicidæ), owing its name to its extremely thin and transparent shell, which is of a pale sea-green colour. The whorls of the shell are few in number, the aperture wide, and the spire short. The animal has an elongated body, too large to be completely retracted within the shell. The mantle is produced into a kind of shield in front. The teeth are numerous. The glass-snail is found in Britain. Species of the genus Vitrina are very numerous and abound in the northern regions of the Old World. They are very hardy, and are found in woods, among decayed leaves, grass, stones, &c.

GLASS-SNAKE (*Ophisaurus ventralis*) is a lizard, not a serpent, as its name would suggest. The body is extremely serpent-like, and there is no trace of limbs. The glass-snake is a native of North America, inhabiting the southern states of the Union. It is between 2 and 3 feet in length. The tail, which is considerably longer than the body, is extremely brittle, and breaks off in several places when struck. The body is of a greenish-brown colour, regularly marked with numerous spots and streaks of yellow. The glass-snake is a harmless and timid animal, and feeds upon insects, small reptiles, frogs, &c. This lizard belongs to the family Zonuridæ.

GLASS'WORT (Salicornia), a genus of plants of the order CHENOPODIACEÆ, or goose-foot family. They are mostly weeds, inhabiting moist salt districts on the coasts of the north of Europe, Africa, and America. *Salicornia herbacea* and *Salicornia radicans* grow on muddy sea-shores in Great Britain. They contain much soda, and some Mediterranean species were at one time much used along with saltwort (*salsola*) in the manufacture of *barilla*, or carbonate of soda, for use in glass and soap making. Soda is now obtained from other sources. *Salicornia*

herbacea is often eaten as a salad or pickle under the name of Samphire, but is a different plant from the true samphire (*Crithmum maritimum*), which grows on rocky coasts.

GLASSY FEL'SPAR is another name for SANIDINE, which is a variety of ORTHOCLASE that occurs as vitreous transparent crystals in some highly silicious lavas and volcanic rocks.

GLAS'TONBURY (the Anglo-Saxon *Glæstingabyrig* or Green Isle), a market-town and municipal borough of England, in the county of Somerset, on the Somerset and Dorset Railway, 132 miles from London, stands on an eminence which is nearly insulated by the surrounding alluvial flats. These, formerly encircled by the arms of the Brue, formed the Roman *Insula Avalonia*—island of Avalon or Apples, the legendary burial-place of King Arthur. The town consists of several streets; four of these include a quadrangular space, in which the ruins of the famous abbey of Glastonbury—so interesting as the one undoubted link between the Christianity of Roman Britain and Saxon England—are comprised, and from the corners of this quadrangle other streets extend. There are some handsome shops and large residences in the High Street, but the old houses are generally low, and many of them were built with the stones taken from the abbey ruins. These consist of some fragments of the church, the chapel of St. Joseph of Arimathea, and what is called the Abbot's Kitchen. The portion in the best state of preservation is St. Joseph's Chapel, transitional Norman, erected in the reigns of Henry II. and Richard I., a singularly graceful specimen of the architecture of that period. Below the floor is a Norman crypt, and within it St. Joseph's Well, supplied from a mineral spring under Glastonbury Tor, a hill 500 feet high, which overlooks the town. The remains of the church are not so important, but are scarcely less interesting. In the cemetery were buried, according to the tradition, King Arthur and his queen Guinevere, and Joseph of Arimathea. Henry II. caused a search to be made for the graves of the former, and discovering their supposed coffins, deposited them in a magnificent shrine before the high altar. Among the famous abbots of Glastonbury have been St. Patrick, St. Benedict, and St. Dunstan. At the time of the Reformation the abbey was celebrated for its wealth and magnificence, which excited the cupidity of Henry VIII.; and its last abbot, the unfortunate Whiting, unwilling to surrender it, was hanged without trial on the Tor Hill in 1539, and afterwards quartered. The Abbot's Kitchen is a curious square massive building, with a stone roof in the shape of an octagonal pyramid, erected about 1370–1420. At one time the abbey and grounds covered 60 acres. The other interesting structures in this fine old town are—the market-cross, in the Decorated style; the town-hall and market-house; St. Benedict's Church, partly rebuilt by Abbot Beere in 1493–1524; St. John the Baptist's, recently restored, a stately building, with a grand Perpendicular tower, in three storeys, 140 feet high; the George Hotel, formerly the abbey hospitium; the Pilgrim's Inn, on the site of the great gatehouse at the entrance to the abbey grounds; Congregational and Wesleyan chapels; extensive police barracks, recently erected; two branch banks, &c. The borough is the headquarters of the county constabulary, and has a considerable export trade in timber, slates, tiles, and agricultural produce, formerly carried over the canal that runs to the Bristol Channel, but the greater portion of which is now conveyed by railway. Two miles S.S.W. of Glastonbury is the rapidly improving village of Street, with about 2000 inhabitants, and containing a very large establishment for the manufacture of boots and shoes, &c. Near the town is Weary-all Hill, a name corrupted from the Celtic title for it, *Wirral Hill*, where a stone marks the spot on which Joseph of Arimathea is said to have planted his staff. The miraculous thorn which blossomed here in winter was, until the times of the Puritans, generally believed to be the very staff with which the saint had made his way from Palestine. The tree was destroyed during the civil wars, but grafts from it are still to be found in the neighbourhood. Prior to the Reformation, Glastonbury returned two members to the House of Commons. The municipal borough is governed by a mayor, four aldermen, and twelve councillors. The population in 1881 was 3828.

GLAS'TONBURY THORN, according to popular tradition, sprang from the staff of Joseph of Arimathea, when he built a church at Glastonbury and preached Christianity to the British. It blossomed on Christmas Day, and pilgrimages were frequent during the middle ages to the sacred spot. It is probable that it was an early flowering variety of the hawthorn, known to gardeners as *Cratægus Oxyacantha præcox.* Instances are known of this variety bearing flowers in December together with ripe fruit.

GLATZ, a town of Prussia, in the government of Breslau, 16 miles S.S.W. from Frankenstein, and 52 miles from Breslau, with which it is connected by railway. It is a strongly fortified town situated in a narrow valley on the left bank of the Neisse, and has 13,000 inhabitants, including the garrison. It is surrounded by walls, and defended by an old castle built on a high hill, besides a regular modern fortress erected on the opposite height. Linen, leather, damask, broadcloth, rose garlands, and hosiery are manufactured. The town has a gymnasium and a Catholic college. It was taken by the Prussians in 1742, recaptured by the Austrians in 1759, and fell into the hands of the Würtemberg and Bavarian troops in 1807.

GLAU'BER'S SALT is hydrated sulphate of soda ($Na_2So_4+10H_2O$), having a hardness of 1·5 to 2, and a specific gravity of 1·48. It crystallizes in oblique rhombic prisms of the monoclinic system, but naturally is generally found in yellowish efflorescent crusts, and is produced in very large quantities in the manufacture of carbonate of soda. It is used in medicine and known as "salts," its action being purgative. The name has been acquired from its discoverer, Glauber, a German chemist, but it is also known as Mirabilite.

GLAUCO'MA (Gr. *glaukos*, sea-green) was the name originally applied to a disease of the eye characterized by the pupil losing its naturally black colour and presenting a clear or dull greenish hue. It is now used to denote all the conditions which are produced by a morbid increase of tension within the eye from an excess of its contained fluids, whether the sea-green appearance be presented or not. These affections sometimes come on very rapidly, but more generally there is a gradual obscuration of vision as the tension increases, which, if not relieved, leads to the total loss of sight. The presence of glaucoma is ascertained by the appearance of the eye, the manner in which vision is affected, and by means of gentle pressure applied to the eyeball, from which a skilled oculist can ascertain the existence of a morbid increase of tension in the majority of cases where it is present. Formerly medical treatment was relied on for the cure of this class of diseases, with the mournful result that they were generally regarded as hopeless and incurable. The treatment is now entirely surgical, and it is happily found that glaucoma is, in the majority of cases, capable of arrest by means of an operation. If performed early vision may be restored to its integrity, and even where the disease has made progress it may be arrested and partial sight preserved. Hence it is always desirable to give early attention to such affections, and in the majority of cases the operation necessary should be performed as soon as possible.

GLAU'CONITE (from Gr. *glaukos*, sea-green) is a greenish hydrous silicate of iron and potash that occurs extensively in some beds of the European Cretaceous, and

less abundantly in some of the Oolitic, Triassic, and Silurian series. It is mostly found among sandstones and limestones, either enveloping the grains or forming the casts of Foraminifera or filling shells of Rhizopods. It has probably been deposited by organic agencies, as it is found over the existing sea bottom off the coast of Georgia and South Carolina filling the pores of corals and cavities of rhizopod shells. Its hardness is 2, and its specific gravity from 2·2 to 2·4, with a dull or glistening lustre.

GLEANING. The practice of gleaning in corn-fields what the reapers of the harvest leave behind is vulgarly supposed to be a legal custom which the "owner or occupier of the field has no right to prohibit, and that the poor who enter a field for this purpose are not guilty of trespass," but the only authority in support of this view is an extra-judicial dictum of Lord Hale. Blackstone, in his "Commentaries," book iii. c. 12, remarks that this humane provision seems borrowed from the Mosaic law (Lev. xix. 9; xxiii. 22, &c.), and apparently adopts Lord Hale's opinion. The question has, however, been twice tried in the Court of Common Pleas, and it has been properly decided that a person can claim no such right. (1 H. Bl., "Rep." 51, quoted in Christian's edition of Blackstone's "Commentaries," vol. iii. p. 213.)

The custom in many parts of England is to allow the poor to glean, in some cases before the harvest is carried, but more generally not until afterwards.

GLEBE LAND, the portion of land which is attached to a parish church for the maintenance of the incumbent. If there be both a rector and a vicar the glebe land in the occupation of either does not pay tithes, though if in the occupation of a tenant it does. The representatives of a deceased incumbent are entitled to the corn sown by him on the glebe. Various statutes have from time to time been passed to facilitate the exchange of glebe lands, which are often scattered in small parcels in different parts of the parish. At one time it was thought so important that glebe lands should be attached to a church that in their absence consecration could not be performed. In England the house and glebe are included under the term manse, but in Scotland glebe is now usually limited to the lands and manse to the house.

GLEDIT'SCHIA, a genus of plants belonging to the order Leguminosæ and the tribe Eu-cæsalpinieæ. *Gleditschia Triacanthos* (the three-horned acacia or honey locust) is a large tree, native of the Carolinas and Virginia; it attains a height of from 50 to 80 feet. When the tree is young the trunk and branches are covered with small prickles, which become hard as it increases in age, and form a formidable defence. The foliage is of a light shining green, and is particularly elegant. In the neighbourhood of London the leaves do not appear till late in the spring, and drop off early in the autumn. The seeds are covered with a sweet pulp, which, when infused and fermented, forms an intoxicating liquor that is used by the American Indians. There are four or five species of Gleditschia enumerated, all of which possess the same general characters. As ornamental trees they are much esteemed, both on account of their elegant foliage and the varied and picturesque forms assumed by the tree, together with the singular appearance of the spines. They require a deep rich soil in a situation not exposed to high winds. The species are trees, with bipinnate and often pinnate leaves on the same tree. The flowers are small, greenish or white, some with stamens and pistils, others with either stamens or pistils. The calyx has from three to five narrow segments free down to the disc, scarcely covering the petals. The pod is flat, generally indehiscent, and pulpy inside.

GLEE, in music, is by no means invariably a joyful composition. If, indeed, it is otherwise than "serious," it was usually called a "cheerful glee" in the palmy days of glee-writing. The word, indeed, means music itself, being the Old English *gligg;* the gleeman or *gliggman* being the harper or singer.

The term *glee* is now limited to a certain species of vocal composition, properly unaccompanied, and for one voice to a part (though Sir Henry Bishop was fond of writing glees with accompaniments and chorus), which grew up at the beginning of the eighteenth century, and is still written. Samuel Webbe was the perfecter, almost the inventor of the glee. The modern part-song, often little more than a harmonized melody in several verses, is so much easier to write, to sing, and to listen to that in these days the fine composition of the glee is somewhat neglected. The best way of describing it would be to compare it with the madrigal, which had died out early in the seventeenth century. The madrigal was in counterpoint, full of devices of imitation and canonic passages, clinging to the old ecclesiastical modes, written for several to a part, all in one movement, and that short, almost entirely eschewing changes of key or accidentals. The glee, on the other hand, is free in its harmony, and if learned is carefully studious to conceal its learning; is plentifully supplied with changes of key and tempo, so that several movements are not uncommonly found in it; is as full of character as the subject permits, and affords opportunities to each voice for passages in the nature of a solo. Such a varied style almost limits the glee to a voice to each part. Glees are, it is true, often sung in chorus, but without severe training the experiment is unsuccessful, as a certain air of improvisation and unstudied grace is necessary to a fine performance of this style.

The finest glee writers are Samuel Webbe, Sir J. W. Calcott, Horsley, Stevens, Spofforth, Danby, Lord Mornington, Battishill, Attwood, and Sir Henry Bishop.

Since the most consummate learning may be and often is employed in glee-writing, in addition to the perfect freedom and variety it affords, it is not too much to say that the glee is the highest point yet attained in purely vocal composition. It is almost exclusively English.

GLEICHENIA'CEÆ. See FERNS.

GLENCOE', a glen of Scotland, in the county of Argyle, near the head of Loch Etive, extending from Ballahulish in an easterly direction for 10 miles, within which distance are but one or two solitary farmhouses. The vale is edged on both sides by almost perpendicular mountains of grotesque forms, 3000 feet high, in the clefts of which snow lies all the year round. Its bed is swept by Ossian's "dark torrent of Cona;" and no other portion of the Highlands presents such a scene of gloomy sublimity. It was in a quiet and fertile valley here that the massacre of the Macdonalds occurred in February, 1692, and the ruins of the cottages of the murdered clansmen may still be seen embedded in greensward and moss, and overshadowed by the rich trees. The principal circumstances of this atrocious deed are as follows:—The government of William and Mary were very anxious to promote peace in Scotland, and issued a proclamation offering pardon to every rebel who would swear, on or before the 31st of December, 1691, to live peaceably under their majesties, and threatening to treat all who refused to do so as enemies and traitors. All the chiefs submitted in time except Mac Ian, the chief of the Macdonalds of Glencoe, who delayed to give in his submission till the 6th of January. The certificate of his oath of allegiance, with explanatory circumstances, was suppressed by intrigue, directed, it is supposed, by Sir John Dalrymple, afterwards Earl of Stair. Mac Ian's enemies soon formed their plans for his destruction. They obtained the king's signature to an order directing the commander of the forces to "extirpate that set of thieves, the Macdonalds." Accordingly, on the 1st of February 120 soldiers, mostly Campbells, who had a personal spite against the Macdonalds, marched to Glencoe. They there simulated friendship, and lived for twelve days with their

victims, carefully observing what means of escape they had, and reporting the same to Lieutenant-colonel Hamilton, who was approaching with troops to secure the passes. The morning of the 13th was fixed for the massacre; and on the night previous Campbell was drinking and playing at cards with those whom he was to murder before dawn. Hamilton did not arrive in time to stop the passes, and about 300 men and women escaped, but in many cases only to die of cold or hunger. The rest, numbering thirty-eight men, women, and children, were butchered in cold blood, the huts of the village set on fire, and their flocks and herds driven away by the troops. This villany was completed before daybreak, the victims being murdered in their sleep.

GLENDOWER or **GLENDWR, OWEN,** was born in Merionethshire about the year 1349. He claimed to be maternally descended from Llewelyn, the last native prince of Wales.

Taking advantage of the deposition of Richard, Lord Grey de Ruthyn seized by force a piece of land which Owen had previously recovered from him by due course of law. Owen laid his case before Parliament, but his suit was dismissed. Lord Grey next detained the writ of summons calling upon Owen, with the other barons, to assist Henry IV. in his Scottish expedition, made the king believe that Owen's absence was intentional, and seized his lands under pretence of forfeiture. The Welsh now rose in support of Owen, who laid claim to the throne of Wales. Henry marched against him, but retired after Glendower had retreated to the mountains in the neighbourhood of Snowdon. After much skirmishing, burning, and plundering Owen took the Castle of Radnor. A second expedition, headed by the king, in June, 1401, was again unsuccessful; the army retreated exhausted by famine and disease, while Glendower was daily becoming stronger and more popular. A comet in 1402 was interpreted by the bards as an omen in his favour. Glendower advanced against Ruthyn, and as Lord Grey came forward to resist the attack, he was seized in an ambush, and carried off to the camp near Snowdon. Carnarvon Castle was then besieged, and Bangor Cathedral, and the cathedral, palace, &c., of St. Asaph burnt, on account of the disloyalty of Trevor, bishop of St. Asaph, to Richard II. Trevor himself subsequently joined Owen, and was confirmed by him in the see, till the decline of Owen's power, when the bishop withdrew to Paris.

While the king was preparing a third expedition, Glendower defeated Sir Edmund Mortimer at Pilleth Hill, in Radnorshire, killed 1100 of his followers, and made Mortimer prisoner. Mortimer was uncle to Edward Mortimer, earl of March, then about ten years old, whose title to the English crown had been acknowledged by Parliament, and who was kept in close custody by Henry IV. The uncle, who was left unransomed by the king, and was treated with great respect by Glendower, became his confederate, and they drew into their alliance the powerful English family of the Percys. The estates of Wales were called together at Machynlleth, and there Glendower was crowned, and styled Prince of Wales.

In 1403 Glendower and Mortimer marched towards Shrewsbury to join Percy's army, but before their entire junction King Henry arrived, and an engagement took place at Battle Field, near Shrewsbury, in which Percy fell. In the next year the king secured the Welsh castles, while Owen, on his part, concluded a treaty of alliance with the French king, Charles VI., on the 14th of June, and immediately commenced a vigorous campaign, and took several castles, some of which he dismantled. In March, 1405, he received a severe defeat at Grosmont Castle, from the young Prince of Wales, afterwards Henry V., then in his seventeenth year. Another defeat almost immediately followed in Brecknockshire, where one of his sons was taken and his brother Tudor killed. All Glamorganshire then submitted, and Glendower had for a time to conceal himself in secret and unfrequented places. But the French sent a fleet of 140 ships, which disembarked 12,000 men at Milford Haven; Carmarthen capitulated, and Glendower was able to join the French at Tenby with 10,000 men. The French, however, quitted the country without any important engagement having taken place. Gradually from this time Owen's power declined, though all efforts failed to destroy it entirely. During the reign of Henry V. Sir Gilbert Talbot was empowered to negotiate a treaty with Owen and his followers, but the proceedings were abruptly terminated by the death of Glendower, 20th September, 1415.

GLENROY', a narrow valley of Scotland, in Inverness-shire, through which the Roy runs on its way to the river Spean. The glen has long attracted the notice of scientific men, from having its sides marked with three lines of shelves, now known as the "Parallel Roads of Glenroy." Many theories have been suggested to explain the phenomena. Some have held that they had once been used to carry water for purposes of irrigation; others that they indicated the shore levels of an inland lake at different periods; others that the glen was a former arm of the sea, and that "the roads" mark periods of rest in the elevation of the land; while others trace the markings to glacier action. The last theory was first proposed by Agassiz; it was illustrated by Mr. T. F. Jamieson, and accepted by Sir Charles Lyell in his work on the "Antiquity of Man." In a lecture before the Royal Institution, however, in 1876, delivered after a recent visit to the district and a careful personal inspection of the glen, Professor Tyndall expressed his conviction that the agency which had created these "parallel roads" was that of water, not glaciers; and this view is now generally entertained.

GLENTILT', a deep valley of Scotland, about 15 miles long, in the north of Perthshire, through which the Tilt, a torrent from the Grampians, flows with great rapidity. The scenery of the glen is remarkably wild, and during the months of summer and autumn attracts many tourists from the south. It also presents features of the greatest interest to the geologist.

GLIM'MER is a term that has been used to include several talcose and micaceous minerals, but more recently it has been restricted to potash-mica or MUSCOVITE.

GLOBE-FISH is the name given to certain fishes of the order PLECTOGNATHI, remarkable for their power of inflating their body by filling their stomachs with air. Globe-fishes have a short, thick, cylindrical body, covered with a thick skin without scales, and bearing numerous sharp spines. When the body is inflated it bristles at all points with its spines, and so the name sea-hedgehog given to these fishes is very appropriate. When the globe-fish is inflated and nearly spherical in shape it floats upon the water with its belly uppermost. It is not, however, at the mercy of the winds and waves in this position; not only can it move forward in a straight line, but by the aid of its powerful pectoral fins it can turn round on either side. Many of the globe-fishes are highly poisonous, causing illness and even death when eaten. Some are poisonous only at certain seasons or in certain localities. Hence it is probable that their deleterious qualities are due to their food, which consists of corals, crustaceans, molluscs, &c. Globe fishes have no distinct teeth. The bones of the jaws are more or less blended together, forming a sharp cutting beak. The commonest globe-fishes belong to the genera Tetrodon and Diodon. In the genus Tetrodon the jaws are divided above and below by a mesial suture, forming as it were four teeth. In their other characters the genera present a general agreement. These fishes are remarkable for the shortness of the vertebral column and spinal cord. The pectoral fins are well developed

but the ventrals are absent. The dorsal fin is soft, small, and placed near the tail, opposite to the anal. Globe-fishes are very numerous in tropical and subtropical seas. A few inhabit rivers, as *Tetrodon fahaka*, found in the Nile and rivers of West Africa. Many are very beautiful, glowing with brilliant colours or ornamented with spots or bands. The largest species, *Diodon hystrix*, sometimes attains a length of 2 feet 6 inches. The only British species (found on the coasts of Cornwall and Ireland) is *Tetrodon lagocephalus*.

GLOBE-FLOWER (*Trollius europæus*), a species of plant of the order RANUNCULACEÆ, a native of Northern Europe. The globe-flower is found in moist upland situations in the north of the British Isles. The name is derived from the shape of the sepals, which are globe-shaped and bright yellow. The petals are small, linear, and flat. The leaves are palmately five-parted. Various species from Europe, Asia, and North America form pretty border plants.

GLOBES, as used in teaching geography, physiography, and astronomy, are miniature representations of the natural globe (with all its geographical divisions), or of the concave expanse of the firmament, with its principal stars and constellations; but this concave is considered as viewed from without, and the *celestial* globe bears its map upon its outer surface like the *terrestrial*. For educational purposes they are of great utility. Besides serving as maps to distinguish the different parts of the earth's surface, or the situations of the fixed stars, they are calculated to illustrate the various phenomena arising from the diurnal and annual motions of the earth, and the different phases and positions of the fixed stars at every period of the year. On these globes there are ten principal circles. The six greater ones are the horizon, the brazen meridian, the equatorial (or equinoctial, as it is called on the celestial globe), the ecliptic, and the two colures. The four minor circles are the two tropics and the two polar circles. Of these circles the equator and ecliptic, with their parallels and secondaries, are fixed; the horizon, with its parallels and secondaries, is movable. The horizon is an important adjunct to a globe. It consists of a broad wooden circle running round it, and which, at whatever angle its axis may be inclined, divides it into two equal parts, called the northern and southern hemispheres. In this circle the brazen meridian slides up and down, according to the different heights to which it is necessary to elevate the pole. The brazen meridian is a ring frame in which the poles of the axis are fixed, and in which therefore the globe freely rotates on its axis. On the flat side of the horizon are described the twelve signs and the months of the year; and on the brazen meridian, which equally divides the globe into eastern and western hemispheres, although the line of division of course depends upon the position in rotation in which the globe finds itself at the moment, are inscribed the different degrees of latitude, each quadrant being divided into 90°. There is also an hour circle, consisting of a flat ring of brass, divided into twenty-four equal parts, or hour distances; and on the pole of the globe is fixed an index, which turns round with the globe, and points out the hours on the hour-circle. On the surface of the celestial globe is represented the concave expanse of the heavens. The stars are all arranged in constellations, under the forms of various animals, whose names and figures are represented on the globe. They were first invented by the ancient astronomers of Egypt, Greece, and Arabia, and are still retained for the sake of distinguishing the localities of the heavenly bodies.

These globes are usually composed of plaster or wood, on which the engraved map or description is pasted. But of late years many ingenious methods have been devised for the purpose of facilitating educational instruction. Globes are sometimes made of papier-maché, divided into twenty-four pieces, which can be taken asunder and reconstructed at pleasure, so as to facilitate removal or the convenient study of any one part of the globe. A cheap paper globe is sometimes to be met with, in which the printed gores are brought together by a string; and although this kind of globe may not be exactly spherical, yet it answers every purpose, so far as ready reference is concerned. There is another kind made of tissue paper and inflated with air, which is very useful in a school or lecture-room. It is sometimes 12 feet in diameter, which admits of the descriptions and various divisions being conspicuously represented. Globes made of slate have come into very general school-use, which have the meridians and parallels of latitude marked upon them, and the written details omitted, in order that the blanks may be filled in by the pupils.

GLOBIGERI'NA is a genus of FORAMINIFERA, the type of a family, Globigerinidæ. These animals are very simple in their organization, being little more than lumps of *protoplasm*, a homogeneous semifluid substance which, according to Professor Huxley, is the "physical basis of life." This body, such as it is, is inclosed in a glassy transparent many-chambered shell. This shell is typically more or less spiral, and is built up of a number of spherical chambers whose walls are pierced by very coarse pores. The exterior of the shell is covered by numbers of long delicate calcareous spines. Through the pores of the shell the protoplasm of the body exudes and spreads over the shell, extending down each of the spines. Globigerina is very abundant in all temperate and tropical seas. At a depth of from 1000 to 2400 fathoms the sea bottom is formed of a fine chalky ooze, to which the name "Globigerina ooze" is given, since it is composed chiefly of the shells of this genus. The CHALK is mainly composed of Globigerina shells.

GLOBIGERI'NA OOZE is a white or gray sticky calcareous mud found over nearly all the bottom of deep seas beyond the reach of sedimentary deposits; it derives its name from being almost entirely composed of the perfect or disintegrated shells of FORAMINIFERA, of the genus Globigerina. The colour of the ooze varies, sometimes being red from ferric oxide, or brown from peroxide of manganese; and mingled with it are the silicious shells of Diatoms and Radiolarians, with a small amount of volcanic dust.

GLOBULAR PROJECTION. See MAPS and MAP-MAKING.

GLOBULAR SAILING. See GREAT CIRCLE SAILING.

GLOB'ULIN or **CRYS'TALLIN,** an albuminous substance found in the crystalline lens of the eye, and in the corpuscles of the blood. Berzelius found 35·9 per cent. of this body in the crystalline lens of the eye. It forms a colourless mass, which dissolves in water to a viscous liquid. It resembles albumen, and has about the same composition. It contains carbon 54·35, hydrogen 7·0, nitrogen 16·5, and sulphur 1·2. The crystalline lens of the eye of fishes contains a modification of this substance which is called Phaconin.

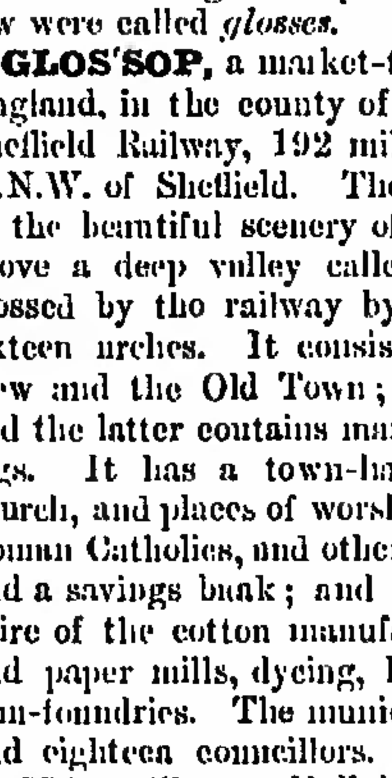
GLORIO'SA, a genus of the order LILIACEÆ, tribe Uvularieæ, so named from the splendid appearance of its flowers. One species, *Gloriosa superba*, is indigenous in India, at moderate elevations on the Himalayas, also in Malaya and Africa. It is a very handsome plant, from 6 to 10 inches high, with a weak stem and tendrilled leaves. It was introduced into England in 1690. There are three species of Gloriosa, natives of Asia and tropical Africa. They have tuberous rhizomes and climbing stems. The flowers are axillary, and have long stalks. The perianth consists of six crimped, reflexed yellow or crimson segments. There are six stamens. The ovary is three-celled, with a three-cleft stigma. The three-valved capsule contains several round red seeds. The species succeed best in

cultivation when planted in a mixture of turfy loam, white sand, and peat. They are placed in a hotbed frame until they begin to grow, then removed to the hothouse and trained. After flowering, the stems are allowed to die down, and the pots are laid on their sides in a dry place till the following March.

GLOS'SARY, a vocabulary containing a list of words contained in any work which are likely to need explanation, owing to their having become obsolete or from any other cause. The word is derived from the Greek *glōssa*, or *glōtta*, tongue, through its use in *gloss*, to describe a word needing explanation, and then for the explanation itself, and for any explanatory note or phrase. There have been numerous *glossaria* written to explain both the Hebrew and Greek portions of the Scriptures, to explain difficulties in the translations, and as marginal notes of different readings. Explanations of the Roman and canon law were called *glosses*.

GLOS'SOP, a market-town and municipal borough of England, in the county of Derby, on the Manchester and Sheffield Railway, 192 miles from London and 19 miles W.N.W. of Sheffield. The town is situated in the midst of the beautiful scenery of the Peak, on a rising ground, above a deep valley called the Dinting Vale, which is crossed by the railway by means of a lofty viaduct of sixteen arches. It consists of two portions, called the New and the Old Town; the former is irregularly built, and the latter contains many respectable shops and dwellings. It has a town-hall, market-house, a handsome church, and places of worship for Wesleyans, Independents, Roman Catholics, and other dissenters; an endowed school, and a savings bank; and is the principal seat in Derbyshire of the cotton manufacture. There are also woollen and paper mills, dyeing, bleaching, and print works, and iron-foundries. The municipality consists of six aldermen and eighteen councillors. Its population in 1881 was 19,574. Glossop Hall is the seat of Lord Howard of Glossop. It is a fine building in the French château style of the eighteenth century, and stands on rising ground above Howard Town.

GLOT'TIS (Gr. *glotta*, the lingual organ), the orifice or mouth of the larynx, through which the air passes during respiration. It is a small oblong aperture which can be dilated or contracted at pleasure, and by its different vibratory motions the tones of the voice are modulated in speaking or singing. Over the glottis is a cartilaginous valve-like organ, called the *epiglottis* (Gr., over the glottis), which has an important duty to perform, and that is to protect the glottis, the larynx, the trachea, and the lungs from the introduction of any foreign substance. When we are in the act of swallowing, it simultaneously closes upon the glottis, and thus protects the passage to the lungs, so as to prevent the food from entering the windpipe. As a general rule, both the glottis and the larynx, with the accompanying organs, are considerably larger in men than in women; hence the great difference in the strength and volume of their respective voices. See also ARYTENOID, CRICOID, THYROID, and VOICE.



The Glottis.

th, the thyroid cartilage; *c*, the cricoid cartilage; *e*, the epiglottis. The vocal chords, *v*, are in the middle of the figure.

The chink between the vocal chords is not, at the utmost, more than three quarters of an inch in length, and varies in width from a quarter of an inch to absolute closure. Hence it must be obvious that a small substance getting in will block it up altogether, and that thickening of the chords from inflammation may narrow it so much as to produce death by suffocation. This is what takes place in fatal cases of croup; layers of a firm whitish substance, of the consistence of boiled white of egg, are formed in the interior of the windpipe, which narrow it and prevent the free ingress of air; and if relief be not obtained from the most active medical treatment, death will speedily ensue. The narrowing of the chink gives rise to the convulsive cough and the peculiar ringing sound of the respiration, which are characteristic of the disease.

GLOUCESTER (pronounced and often spelt *Glo'ster*), an inland county of England, is bounded E. by Oxford, N. by Warwick and Worcester, W. by Hereford and Monmouth, and S. by Somerset and Wilts. The greatest length, N.E. to S.W., is 60 miles; the greatest breadth, E. to W., is 43 miles. The area is 1258 square miles, or 804,977 acres. The population in 1881 was 572,433.

Surface, Hydrography, &c.—The county is naturally divided into three districts, the hill, the vale, and the forest districts. The hill district is formed by a range of high land, the Cotswold Hills, running entirely through the county from north-east to the south and south-west. Its course is nearly parallel to the Avon and Severn, at a distance varying from 6 to 10 miles, and it divides the basin of the Severn from the basin of the Thames. The vale district lies between the hills and the Severn, and is divided into the vales of Gloucester and Berkeley, which are together about 40 miles in length. The forest district lies west of the Severn; it has an irregular surface, and is chiefly occupied by the Forest of Dean, great part of which is still crown property. Many encroachments or grants of freehold property have been made on it from time to time; but the quantity of ground still retained by the crown is above 20,000 acres, which grows timber fit for shipbuilding. The government of the forest is vested in a lord warden, who is constable of the Castle of St. Briavel's; six deputy wardens, four verderers chosen by the freeholders, a conservator, seven woodwards, a chief forester in fee and bowbearer, eight foresters in fee, a gaveller, and a steward of the swainmote.

The principal rivers in Gloucestershire are the SEVERN, the Wye, the Lower and the Upper Avon, the Frome, the Isis or Thames, the Calne, the Windrush, and the Ledden. The Severn enters the county from the north a little to the west of Tewkesbury, and has a course of 60 miles to the Lower Avon, where it leaves the county; it incloses a small tract called Alney Island, near Gloucester; it has a tidal rise of 42 feet opposite the Lower Avon. The Lower Wye bounds a portion of the county on the west. The Upper Avon has a small portion of its course in this county. The North Frome flows through Bristol, and forms a part of the harbour. The Ledden passes through this county about 16 miles, from Donnington to Alney Island. The Stroud rises near Brimpfield, passes on to Stroud, and joins the Severn 7 miles south-west of Gloucester. The Calne rises near Cheltenham, and joins other tributaries of the Thames at Lechlade. The Leach and the Windrush are small rivers. The THAMES in the upper part of its course is often called the Isis. There are several canals in Gloucestershire, and it is also well supplied with railway accommodation.

Geological Character.—The whole range of the Cotswold belongs to the lower division of the oolitic series. The great oolite forms a flat table-land on the summits; and on the western escarpment beds of fullers' earth, inferior oolite, and marly sandstone occur. The whole of the vale district rests on the lias formation. The south-west corner of the county is occupied by the coalfield. The whole of the Forest of Dean is a coalfield encircled by an elevated border of carboniferous limestone and old red sandstone.

The fossils of this county are extremely numerous, and are found both in the hills and the vales. Iron appears to have been wrought here during the Roman occupation; and we find it recorded in the reign of Edward I. that there were then seventy-two furnaces for smelting it in the forest. The ore is not very rich in metal. Two hundred pits have been opened for the coal in different parts of the forest, but it is not considered so good as that of Staffordshire. Lead ore is found in many parts of the county, but not in sufficient quantities to defray the expense of working. Pyrites, or sulphuret of iron, has been found in great abundance. Lapis, calaminaris, petrosilex, barytes, quartz crystals, gypsum, limestone, and freestone are met with in the county.

Manufactures.—These are numerous and important. The cloth manufacture is extensively carried on at Wotton-under-Edge and Stroud. At Frampton-Cotterell, Winterbourn, Bitton, and Westerleigh there are considerable hat and felt manufactories, and some persons are also engaged in stocking-making. The last-mentioned manufacture is extensively pursued at Tewkesbury, where frame and lace making likewise give employment to some of the inhabitants. In Gloucester and in the suburbs of Bristol there are pin manufactories. At Newland and English Bicknor tin-plates are made. Edge tools are made at Cooley, and glass-bottles in the suburbs of Bristol. At Moreton and a few other places cheese-cloths and other articles of linen are made. The large commercial city of Bristol has also several manufactories of brass, iron, floorcloths, lace, hats, soap, vinegar, &c.

Climate and Agriculture.—The climate of Gloucestershire varies according to the elevation of the land. In the valleys the temperature is mild. On the Cotswold Hills the air is sharp and bracing. The Vale of Gloucestershire is noted for the early maturity of every kind of agricultural produce, owing partly to the nature of the soil, but chiefly to the shelter afforded by the hills on the north and east.

The soil on the Cotswolds is chiefly a calcareous sand, a few inches deep, resting on oolite. The poorest is only fit for sheep-pasture, but sheep thrive well on it. Where it has been improved by cultivation it bears tolerable crops. The lower parts of the hills, and the valleys which are between them, contain a better and a deeper soil. The vale has mostly a deep and rich soil. According to the agricultural statistics published in 1884, there were 655,000 acres, or more than four-fifths of the entire area, under cultivation. Corn was grown on 160,000 acres, green crops on 60,000, clover on 85,000, and 330,000 were in permanent pasture.

Flax was formerly cultivated to some extent in the vale, but the belief that it was a very scourging crop, and returned nothing to the land, led to its general prohibition in leases. Potatoes are raised in the rich light loams in considerable quantities. In a county of which the greatest part of the subsoil is calcareous, saintoin is a most valuable production; it grows in poor chalky soils, and remains in vigour for many years. Teasels are raised for the use of the manufacturers of woollen cloth, but not to such an extent as formerly.

Gloucester contains grass-lands and meadows equal for richness to any in the kingdom. In fact it is essentially a dairy country, and has been always renowned for its butter and cheese. The Gloucester breed of cows, although now eclipsed in public estimation by the improved shorthorns and the Devon, has qualities which make them still favourites with many experienced dairymen. The produce of a good cow averages from $3\frac{1}{2}$ to $4\frac{1}{2}$ cwts. of cheese in the year. The sheep peculiar to this county are the Cotswold and the Ryeland breeds. The first are large in the carcase, and rather strong in the bone, and the wool is coarse. The Ryeland or Herefordshire sheep are bred in the forest district, and are rather small. The number of cattle in the county in 1884 was 112,000, and of sheep 350,000. There are fine orchards in different parts of the vale and forest districts, and some very good cider and perry are made in the county.

Divisions and Towns.—Gloucestershire is divided into twenty-nine hundreds. It is in the diocese of Gloucester, and in the Oxford circuit. The assizes are held in the city of Gloucester. Since the Reform Act which came into operation in 1867 the county has been divided, for parliamentary purposes, into East and West Gloucestershire, returning two members each; the boroughs of Gloucester and Stroud return each two members, and those of Cheltenham, Cirencester, and Tewkesbury, one each—total, eleven members.

History and Antiquities.—On the division of the island into Britannia Prima and Britannia Secunda, after the conquest by the Romans, in A.D. 45, that part of Gloucester which lies south-east of the Severn was included in Britannia Prima, the other part in Britannia Secunda. After the subsequent division made under Constantine, the county, or the greater part of it, was included in the part named Flavia Cæsariensis. From the ruins which have been at different times discovered in various parts of the county, it was evidently much occupied by the Romans. Cirencester was the metropolis, while Gloucester and the hills about the Severn were the great military positions. Gloucester formed part of the Mercian kingdom in Old English times, and was much harassed by the Danes. After the Norman Conquest the county was disturbed by the contest between Stephen and the Empress Maud, then by the wars between Henry II. and the Welsh, then by the disputes between John and the barons, and afterwards by the Wars of the Roses. In the Civil War of a later period, between the Parliament and the Crown, many contests took place in different parts of Gloucestershire.

The principal Roman roads in the county are the Foss Way, Ermine Street, Ikenield Street, and the Via Julia. There are several traces of Roman camps in this county, in which coins and other antiquities have been found. Near Sydney Park are the remains of a Roman bath, of an elliptic form, about 8 yards in length. Various foundations of Roman buildings and other antiquities have also been found near Cirencester. But Woodchester, which is a small village about $2\frac{1}{2}$ miles south-west of Stroud, is the most celebrated place in the county for the number and beauty of the Roman antiquities found. A great tesselated pavement was discovered in the digging of graves in the churchyard of this village; it appears to have been a square of 48 feet 10 inches, with a very rich design. Various foundations of apartments and tesselated pavements of different patterns have been found within the churchyard and contiguous to the great pavement. There are many traces of British, Saxon, and Danish works in this county, as well as of Roman. At Beachley, a point of land at the mouth of the Wye, extensive earthworks are still remaining, probably of British origin. Offa's Dyke terminates here, and may be clearly traced crossing the road at Buttington Tump. Camps, tumuli, and other remains of antiquity are numerous.

There are some fine old family seats in the county, some of which are of very ancient date, and there are also ruins of castles and abbeys. Among the most distinguished of these is Sudeley Castle, built in the reign of Henry VI., and now in ruins; Badminton House, built in 1682; Barnsley House, a structure in the Italian style; Burrington Hall, built in 1734; Berkeley Castle; Blaize Castle, near Bristol; Highnam Court, built during the Protectorate; Oakley Grove, built early in the last century; and Southam House, a venerable mansion of Henry VIII.'s time, which retains more of its original form than perhaps any other domestic building in England of that era.

GLOUCESTER, a city, county of a city, port, and the capital of the above county, 104 miles W.N.W. from London in direct distance, or 114 miles by the Great Western Railway. It is pleasantly situated upon a gentle eminence which rises on the eastern bank of the Severn, about a mile above the confluence of the two channels into which that river is divided by the island of Alney, and about 40 miles above its junction with the Bristol Channel. The origin of this city is generally attributed to the Britons. Shortly after the invasion of Britain under the Emperor Claudius, A.D. 44, the city became subjected to the Romans, who established a colony here as a check upon the Silures, or inhabitants of South Wales, and called it Colonia Glevum. The city continued in the possession of the Romans up to the period of their leaving the island. It subsequently surrendered to the West Saxons about the year 577, and by them was called *Gleau-Cester*.

It was repeatedly visited by William I., afforded a refuge and support to the Empress Maud in her contest with Stephen, was the place where Henry III. was crowned and Parliaments were held under Richard II. and Henry IV., and sided successfully with the Parliament in the Civil War against Charles I.

The main streets of the city are at right angles, and the town is clean and well-built. The water for the supply of the inhabitants is partly drawn from the Severn, and partly from springs situated near Robin Hood's Hill, about 2 miles distant from the town. Of the public buildings, the cathedral is particularly deserving of notice. The most ancient parts are the crypt, the chapels surrounding the choir, and the lower part of the nave, built between 1058 and 1089, the south aisle and transept in 1310–30, the cloister in 1377–1412, and the Lady Chapel towards the close of the fifteenth century. The fine Gothic tower, surmounted by four pinnacles of the most delicate workmanship, is of somewhat more recent date. The choir, owing to the great elevation of the vault, the richness of the design, and the elaborate tracery of the eastern window, is an exceedingly fine specimen of the florid style of architecture. The length of the cathedral is 427 feet; breadth, 154 feet; height of the tower, 223 feet. The whole building has recently been thoroughly restored both externally and internally.

There are, besides the cathedral, numerous churches, some of them very handsome, and chapels for nearly every denomination of dissenters. From the Church of St. Michael the curfew bell is still rung every evening. The town-hall is a fine building, erected by Smirke in 1814. The other chief buildings are the episcopal palace, shire hall, county infirmary, lunatic asylum, alms-houses, gaol, corn exchange, cattle market, theatre, literary and scientific institutions, the school of science and art, assembly-rooms, and pump-room over a spa. A statue of Bishop Hooper is erected near the spot of his martyrdom.

There are two stone bridges, each of a single arch, over the two channels of the Severn. These are connected by a paved road, called Over's Causeway, which extends through the rich pasture land of Alney Island. The manufactures of Gloucester were formerly much more extensive than at the present time, especially pin-making. The town, however, is in a flourishing state, and is surrounded by a large and most fertile district. It has extensive water communication, and the improvements in the navigation of the Severn, by the completion of the Gloucester and Berkeley Canal, added considerably to its foreign and domestic commerce.

The docks are spacious, and communicate by means of the canal with the open part of the Severn below Sharpness Point. The wharves are about 1000 feet in length, and are directly connected with the various railways. There are also large dry docks and slips. At Sharpness Point, which is included within the port of Gloucester, extensive dock works were opened in 1875. Prior to this many vessels chartered to Gloucester were obliged to discharge at the South Wales ports, the old opening to the canal not being large enough. The port has a large coasting trade, and there is a good foreign trade with the Black and Baltic seas, Canada, the West Indies, and France. The number of vessels registered at the port in 1884 was 260 (12,500 tons). The entries and clearances each average over 4500 vessels of about 420,000 tons per annum. The customs revenue in 1883 was £10,340. Gloucester is admirably supplied with railway communication to all parts of the kingdom; and besides affording a market for the surrounding district, it imports corn, timber, wines, and spirits in considerable quantities, and has a large export trade.

There are three endowed schools, viz. the college school, the blue-coat, and the free grammar school of St. Mary de Crypt, and numerous other schools; several hospitals of ancient foundation, county infirmary supported by voluntary donations, and a lunatic asylum.

The city of Gloucester is a municipal borough, divided into four wards, and governed by nine aldermen and twenty-seven councillors. The population in 1881 was 36,521. The parliamentary borough returns one member, having lost one by the Act of 1885. The spring, summer, and winter assizes are held at Gloucester, and it is the place of election for the east division of the county.

The bishopric of Gloucester was founded by Henry VIII., and united with that of Bristol in 1836. It was disconnected in 1884, and a separate bishopric created for Bristol and its more immediate neighbourhood. The bishop's income is £5000 per annum, with a seat at Rodborough Manor, Stroud. Gloucester is one of the three cities at which the grand triennial musical festivals of the choirs of Worcester, Hereford, and Gloucester are held. It is the birthplace of the eloquent Whitfield (to whom an elegant memorial church was erected in 1871), and the benevolent Raikes, the latter of whom here originated Sunday schools.

GLOUCESTER (Glo'ster), a seaport town and fishing station of the United States, in the state of Massachusetts, about 28 miles from Boston, with which it is connected by railway. It has a large and safe harbour, deep enough to admit the largest vessels. The town is well-built, and finely situated. It is much resorted to for sea-bathing. It had a population of 19,329 in 1880, the majority of whom are employed in the cod and mackerel fisheries. The town has, besides, manufactories of soap, candles, oil, anchors, cables, and sails. Norman's Woe, the scene of the wreck of the *Hesperus*, famous in Longfellow's poem, is about 2 miles distant.

GLOUCESTER, STATUTE OF. See QUO WARRANTO.

GLOVE (from the Old English *glof*), a cover for the hand. The etymology of the English word shows an early use of gloves in this country. In the middle ages they formed a rich and costly article of the dress of important personages; and jewels were frequently mixed with splendid embroidery on their back. Gloves are made of various materials, such as silk, wool, linen, cotton, fur, and many kinds of leather. The latter material is the most abundantly used. A few of the best gloves are made from real kid skins, but the greater part of so called "kid" are made of lamb's skin. Gloves termed dogskin, buckskin, doeskin, are made chiefly from sheep-skin, and some of the thicker kinds from calf-skin. The leather used in the manufacture of gloves is not, properly speaking, tanned, but prepared by a peculiar process which renders it soft and pliable. The great seats of the leather glove manufacture in England at present are—Worcester, Woodstock, Yeovil, Leominster, Ludlow, and London. The French, however, still excel us in this branch of manufacture. Care in cutting out is the

great point, beyond the fineness of the leather. Beau Brummel, in the height of his glory, had the thumbs of his gloves cut by one artist and the fingers, &c., by another. Before 1825 French gloves were prohibited to be imported. This prohibition had the effect, by preventing all competition and emulation with the foreigner, of checking improvement and of rendering British gloves high in price and inferior in quality.

Worsted gloves are made chiefly in and near Leicester, cotton gloves in Nottingham, and silk gloves in Derby. The manufacture of these three kinds is closely connected with that of stockings.

White Gloves.—At what is called a maiden assize, or when there are no prisoners to be tried, it has from time immemorial been the custom of the high sheriff to present the judges with white gloves. The clerk of assize and the judge's officers have money given to them on the same occasion, which is called glove-money. Formerly, on the application for the reversal of an outlawry, the defendant was obliged to appear personally in court and present gloves to the judges. The custom of presenting white gloves to the judges on a maiden circuit is also observed in Scotland.

GLOW'WORM is the name applied to beetles of the family Lampyridæ, which have the power of emitting light; the latter part of the word has reference to the worm-like appearance of the females of some species. The family Lampyridæ is noticed in the article FIRE-FLY; the present article will be confined to the common English species, to which the name glowworm is especially applicable. This insect (*Lampyris noctiluca*) is rather more than half an inch in length, of a blackish colour; the thorax is margined with dusky red, the legs and the edges of the segments of the body of the same colour. The female closely resembles the larva; she is quite destitute of wings, and the terminal segments of the abdomen beneath are yellowish; the body is very soft, of an oblong form, pointed at the extremity; the thorax is semicircular; the legs and antennæ are very short. The male glowworm emits the phosphorescent light in a slight degree, but it is chiefly the female from which the brilliant light proceeds which is so often seen on banks, beneath hedges, and in various other situations. The luminosity of the glowworm is due to the concentration of phosphorescent granules in the hinder part of the abdomen. According to Matteucci these granules do not contain phosphorus, but form part of a yellowish-pulpy tissue which is permeated with nerves and numerous fine air-tubes (tracheæ). The tracheæ supply the oxygen by means of which the combustion goes on. The emission of light is under the control of the insect's will. Glowworms will live a long time in vacuo, and in different kinds of gases—the nitrous acid, muriatic, and sulphurous gases excepted, for in these they soon expire. When placed in hydrogen gas they sometimes detonate. If the luminous portion of the abdomen be removed it retains its luminous property for some time, and when apparently extinct it may be reproduced by softening the matter with water. The insects emit a brilliant light if immersed in warm water, but in cold water it is extinguished. As the females are wingless, and consequently restricted in their powers of locomotion, and the insects are nocturnal in their habits, the light serves to conduct the sexes to each other. The larvæ may be kept alive for a considerable time; they feed voraciously upon snails, killing those of the largest size; sometimes they seize a snail while crawling, and when the animal retires within its shell they still keep their hold, and allow themselves to be carried into the shell with the snail, and although they become enveloped in the mucous secretion, it appears to adhere to their bodies very seldom. Upon being touched or disturbed they emit the phosphorescent light, but not to so great a degree as the perfect insect.

GLOXIN'IA is a genus of plants belonging to the order GESNERACEÆ. The species are cultivated in hot-houses in this country, not only for their delicately tinted flowers, but also, in some species, for the rich colour of the under-side of the leaves. The corolla is campanulate, with

Gloxinia.

five short unequal lobes. The anthers cohere by their apices to form a square. The disc forms a ring. The ovary is almost altogether inferior, and the stigma is concave. There are six species, natives of tropical America from Brazil to Mexico.

GLU'CIC or **KALI-SACCHAR'IC ACID**, an acid obtained from sugar by the action of acids or alkalies. It is a colourless, amorphous substance, very soluble in water and in alcohol, and decomposes when heated to 100° C. (212° Fahr.) The formula is $C_{12}H_{18}O_9$. It combines with bases, forming a number of salts called glucates; these are generally soluble in water. The glucate of lead is insoluble.

GLUCI'NUM or **BERYL'LIUM** is a rare metal, discovered by Vauquelin in 1798. It occurs as a silicate in beryl, helvite, and gadolinite, and as an aluminate in chrysoberyl. The metal was first obtained by Wöhler in 1828, by fusing the chloride with potassium, but is now prepared by fusing the chloride with sodium in a current of hydrogen. It is a white metal, of specific gravity 2·1. It melts a little below the heat required by silver, and may be rolled into sheets. The symbol is G; the atomic weight is 4·7. It is stable in the air, does not readily oxidize, and does not combine with sulphur at all. It forms a hard brittle alloy with silicon, and is soluble in caustic potash, but not in ammonia. Sulphuric and hydrochloric acids dissolve it with evolution of hydrogen, but nitric acid does not readily act on it. There is only one oxide, called glucina (G_2O); it forms a hydrate ($G_2O\,H_2O$). It resembles alumina, and is soluble in caustic soda and potash. It is a light white tasteless powder, of specific gravity 2·967. Chloride of glucinum (GCl) melts at a gentle heat and sublimes in colourless needles; it is very soluble in water, and very deliquescent. The iodide, bromide, and fluoride are also known, and resemble the chloride. All the soluble salts of glucinum have a sweet

astringent taste. The reactions of the metal generally resemble those of aluminium, but the two metals in solution are distinguished by the action of ammonium carbonate on the precipitates by the alkalies and alkaline carbonates, as it dissolves those of glucinum, but not those of aluminium. Moreover, when heated before the blowpipe with cobalt nitrate, the aluminium compounds give a blue colour, which the glucinum compounds do not.

GLUCK, CHRISTOPH WILLIBALD VON, was born near Neumarkt, in the Palatinate, in 1714, of parents in the service of Prince Lobkowitz. When very young he lost his father, and was totally neglected; but, self-taught, he contrived to work his way to Prague and Vienna, and thence to Italy, where he studied under Sammartini. Lord Middleton brought him, in 1745, to England, where he remained a few years without attracting much notice. He then returned to Italy, where he formed an intimacy with Calzabigi the poet, and the two concerted a reform of the Italian opera, which was carried out in the instances of "Orfeo" and "Alceste," both of which were produced at Vienna, the former in 1762 the latter in 1767. Such was now his reputation that he was invited to compose an opera for the French Académie Royale. For this he wrote his "Iphigénie en Aulide," which was brought out at Paris, under his own direction, in 1776, and completely triumphed over the national prejudices opposed to it. Shortly afterwards, however, a violent and long-continued hostility ensued between two parties at Paris, one of whom espoused the cause of Gluck and the other that of the Italian composer Piccini. Gluck was powerfully aided in his contest by the warm support of the dauphiness, the unfortunate Marie Antoinette, then in the pride of her youthful gaiety and beauty. She had been his pupil at Vienna for the last few years of her residence with her mother, the Empress Maria Theresa, before her marriage to the dauphin (Louis XVI.) She helped him substantially with money as well.

Besides the above-mentioned operas Gluck produced several others, the best of which are "Armida" (1777), "Iphigénie en Tauride" (May, 1779), and "Echo et Narcisse" (1779). He returned to Vienna in 1784, and shortly after was attacked by paralysis, which terminated his life 17th November, 1787. This truly great composer possessed a powerful and original mind, which has placed him in the very highest rank of musicians. He was the creator of modern dramatic music of the serious school. His orchestral colouring, that is to say, the art of heightening the effect by exactly the proper quality of tone and combination of instruments proportioned to the special occasion, is a feature specially admired in Gluck.

GLU'COSE is a sugar found in the juice of grapes, figs, and other sweet fruits; it is often seen in small crystalline concretions in raisins, and is the principal saccharine matter in honey. It is also found in the human body, especially in the disease known as diabetes, when it is voided in large quantity in the urine. It is also obtained by the action of ferments on cane sugar, starch, and dextrine; and by the action of dilute acids on starch and other carbo-hydrates, and by the decomposition of glucosides. Two varieties exist: one is called dextro-glucose, from its action on polarized light, turning the ray to the right—this is the common variety; the other, called lævo-glucose, turns the ray to the left. This is also found in many sweet fruits, in association with the other variety. Dextro-glucose has the formula $C_6H_{12}O_6$, as crystallized from its solution in alcohol; but from solution in water, in which it is very soluble, a hydrate is obtained, $C_6H_{12}O_6H_2O$, in white cauliflower-shaped masses of minute crystals; these melt at 140° C. (284° Fahr.) and become anhydrous. It is soluble in 1½ times its weight of cold water. When heated to 170° C. (338° Fahr.) it is converted into glucosin, $C_6H_{10}O_5$. Strong nitric acid converts it into nitro-glucose. Glucose is manufactured on a very large scale, especially in America, where it is often used for making artificial honey; even the honeycomb is successfully imitated by paraffin wax; the principal application, however, is in the manufacture of beer and porter, where it partly replaces malt. It is made from maize or any of the cheaper varieties of starch by boiling with very dilute sulphuric acid, the acid is precipitated by lime as sulphate of lime, and the solution added to the wort or evaporated in a vacuum pan, and crystallized in large blocks, which resemble butter, for the market. The conversion of cane sugar into glucose is the first step in its ultimate conversion into alcohol. Glucose is recognized in solution by the immediate reduction of cupric salts when gently heated with it. Glucose can be made from cellulose by the action of strong sulphuric acid, which dissolves it, and then boiling the mass in water. Cotton and linen rags can thus be readily converted into sugar.

GLU'COSIDES are bodies often found in plants, which, when decomposed by dilute acids, yield glucose and some other products.

GLUE is an impure variety of gelatin, made from the parings of hides, hoofs, and bones, by boiling them in water for a considerable time, and straining through a wire sieve. The solution is poured into shallow moulds, cut into squares, and dried on a net. It improves by age; and though of a deep brown colour, it should be quite clear and translucent, and should swell considerably on soaking in cold water, but not dissolve except in hot water. Glue is remarkable for its great adhesiveness, tenacity, and toughness. It is a large article of commerce, and much employed in all kinds of joiner work, cabinet-making, and veneering. A softer variety of glue, called *size*, is made from parchment cuttings; it more resembles gelatin, and is used principally by painters, &c., for sizing walls before painting, or for mixing with colours where oil-paint is not employed.

GLUMA'CEOUS PLANTS include grasses, sedges, and three small orders. [See BOTANY.] The series Glumaceæ is so named because the heads or spicules of flowers are inclosed by scaly tracts, called *glumes*.

GLU'TEN, an important constituent in all the varieties of corn used as food, but existing in the largest quantity in wheat. When wheat flour is washed with water on a strainer, the starch and gummy matters pass through, and the gluten remains behind as a tenacious light-brown adhesive mass. It is the substance for which the flour is most valued in the manufacture of macaroni, vermicelli, and paste. It is a nitrogenous substance resembling albumen. It is insoluble in water, but soluble in caustic potash. Alcohol divides it into three principles, one insoluble in this menstruum, called vegetable fibrin; and two soluble, called mucin or vegetable casein and glutin, or vegetable gelatin.

Gluten contains	carbon,	52;	hydrogen,	7;	nitrogen,	15.
Glutin	"	53;	"	7;	"	14.

It is capable of acting as a ferment, and will convert starch into dextrine and glucose. The best wheat flour contains 10 to 11 per cent. of gluten, inferior wheat only 8 to 9 per cent. In some biscuits prepared for diabetic patients the starch is eliminated, and the gluten alone employed; these form a highly nitrogenous food.

GLUTEN-CASEIN and **GLUTEN-FIBRIN.** See GLUTEN.

GLUT'TON or **WOL'VERENE** (*Gulo luscus*) is a carnivorous animal, a species of the weasel family (MUSTELIDÆ). The glutton inhabits all the countries bordering on the Northern Ocean, both in Europe and Asia. In Norway it is very common in Drontheim. In America it inhabits Canada, the fur countries, and the uncultivated portions of the north of the United States, where it is well known in consequence of the depredations it commits. It is a fierce and voracious animal, but by no

means formidable to man or the larger beasts, though its strength is very great in proportion to its size. Slow in its movements, it makes up by perseverance and industry for this defect, and at a steady pace pursues its prey for miles, hunts out weak or dying animals, robs the hunter's traps of their booty, and destroys hares, marmots, and birds, which it seizes unawares. The slanders of old writers respecting the glutton's extreme voracity have been perpetuated in its name. In fact this animal is not more gluttonous than others of its kind. Its cunning and mischievous propensities do not appear to have been exaggerated. The damage it does to the fur trade in America is very great. It follows the track of the marten-hunter, destroying the traps, devouring the bait or the imprisoned marten, or else burying the contents of the trap in the snow. A love of stealing and hiding things in sheer

Glutton (*Gulo luscus*).

wantonness is as characteristic of the glutton as it is of a jackdaw or magpie. The amount of intelligence the glutton displays in evading traps and outwitting his enemy, man, is astonishing.

The glutton is about the size of the common badger, and measures 2½ feet in length, not including the thick bushy tail, which is rather more than half a foot in length, the terminal hairs reaching 4 or 5 inches further. The body is strongly arched, especially along the back. The head is broad and pointed at the muzzle, the ears being short, rounded, and partly concealed by the fur. The jaws are provided with thirty-eight teeth—there being twelve incisors, four canines, sixteen premolars, and six molars, four of the latter belonging to the lower jaw. The limbs are short, and terminate in semi plantigrade five-toed feet, the digits of which are furnished with powerful sharp claws. The fur exhibits a dark maroon or reddish-brown colour, becoming almost black as winter sets in; on either side a light reddish band, inclining to white, extends from the shoulder to the hip, but it is more conspicuous in some individuals than in others. The hair of the tail is black, the under part of the throat and chest being more or less marked with pale whitish streaks.

GLYCE'RIA, a genus of plants belonging to the order of GRASSES, and the tribe Festuceæ. The species are handsome grasses with long stems, and mostly inhabit watery places. There are two species found in Great Britain, *Glyceria aquatica* and *Glyceria fluitans.* They contain a large quantity of saccharine matter, but are coarse grasses. The name is derived from the Greek *glyceros*, sweet. Glyceria is distinguished by the following characters. The spicules have several flowers, and are arranged in a panicle. There are two empty glumes, which are shorter than the two lowest flowering glumes, and unequal and membranous. The flowering glumes are convex, not keeled, with an obtuse scarious tip and from five to seven prominent ribs. The pale is bifid. The fruit is oblong, free. There are thirty species widely dispersed in temperate regions, a few occurring in the tropics. The fruit of *Glyceria fluitans* is often sold under the name of manna seeds. They are sweet and nutritious, and are considered a delicacy for puddings or soups. On the Continent this grass is sometimes grown as a crop. Water-fowl and fish are fond of the seeds, and the grass should therefore be encouraged round ponds, and on the banks of streams.

GLY'CERIC ACID, an acid obtained by the action of nitric acid on glycerin. The formula is $C_3H_6O_4$. It is isomeric with Peruvic acid. Glyceric anhydride, $C_3H_4O_3$, is a brown mass. It combines with bases, forming a number of salts called glycerates.

GLY'CERIDES are glycerin ethers or fats. The natural fats are all compound ethers of glycerin; some of these have been produced artificially.

GLY'CERIN is a sweet, syrupy liquid formed during the saponification of oils and fats. Not many years since glycerin was thrown away as a waste product from soap and stearine candle works, but it is now employed in a variety of useful ways.

Common commercial glycerin is extracted from sweet stearine-liquor, by precipitating the lime by a stream of carbonic acid gas or by a solution of carbonate of soda; the liquor is then boiled a little, filtered, evaporated to a syrupy consistence, and again filtered. The best glycerin is made by introducing superheated steam of from 550° to 600° Fahr. into a distillatory apparatus containing palm oil or other fatty body. The action of the steam effects the decomposition of the fat, and the glycerin and the fatty acids distil over together, but no longer in combination. In the receiver the condensed glycerin, from its higher specific gravity, sinks below the fatty acids. It is concentrated by evaporation.

In its pure state glycerin is a colourless, odourless, uncrystallizable liquid, sweet to the taste, and of a syrupy consistence; it mixes with water in all proportions, does not evaporate or change in the air at ordinary temperatures, and is not susceptible of rancidity or spontaneous fermentation; it is neutral to test paper, and possesses neither basic nor acid properties; it is easily charged with the aroma of the essential oils, and may be combined with soap and many other substances without undergoing change.

Glycerin is extensively employed in pharmacy as an excipient for medicines, and as a solvent. Its solvent properties are considerable, many substances soluble in water being much more so in glycerin. It is used alone or in combination as a soothing emollient, and is added to poultices and dressings instead of oil, to prevent their hardening. Diluted with water it often succeeds in allaying itching and irritation of the skin when all other means fail. As a cosmetic, either made into a lotion or added to soap (glycerin soap), or used in small quantities along with the water employed in washing, it imparts a healthy clearness and a sensation of softness and coolness to the skin which is very agreeable and refreshing. It is the best remedy known for chapped nipples, hands, lips, &c., all of which may be prevented by its use as an article of the toilet. Articles, such as tubs and pails, saturated with it will neither shrink nor dry up; leather soaked in it keeps moist and pliable. It is used for extracting the perfume of flowers, to preserve animal substances from decay, and is employed in dyeing, brewing, liqueur-making, wine-keeping, and many other purposes.

Glycerin is largely distributed in nature; it is a constituent of all oils and fats, in which it is combined with the fatty acids. It is always produced in the alcoholic fermentation of sugar, a fact first pointed out by Pasteur. It has been produced artificially from tribromide of allyl. It is a triatomic alcohol, having the formula $C_3H_8O_3$. Alone it does not distil without decomposition, but is easily distilled in the presence of steam. The specific gravity is 1·260.

It is very soluble in water, alcohol, and chloroform, but not in ether. It does not freeze even at very low temperatures: a solution in water of 50 per cent. has a freezing point of $-31°$ C.; hence it is used in gas meters to prevent freezing, and in freezing machines to convey the cold temperature. It is unaltered by exposure to the air, and it is used as a lubricator in clock-work and other delicate machinery. When acted on by strong nitric acid it forms a terribly explosive compound, called nitro-glycerin, $C_3H_5N_3O_9$. See NITRO-GLYCERIN.

GLY'COCINE or **GLY'COCOL**, or sugar of gelatin, is an organic substance obtained by the action of sulphuric acid or caustic alkalies on gelatin. It crystallizes in hard prisms, which melt when heated, and taste as sweet as grape sugar. It is not very soluble either in water or alcohol; a mixture of these is the best solvent. The formula is $C_2H_5NO_2$.

GLY'COGEN is a starchy substance formed in the liver, our whole knowledge of which, with all the most important issues it involves, is due to the genius of the French physiologist, M. Claude Bernard. This distinguished savant in 1848 studied the course taken by the sugar in the food, which he endeavoured to trace from its absorption by the intestine. Among other experiments he fed a dog for seven days with food containing much sugar and starch (starch, as is well known, becoming sugar under certain conditions), and he then found sugar in the portal veins conveying the blood to the liver for elaboration, and in the hepatic veins conveying the blood away from the liver after elaboration by that organ. Then feeding the dog on meat only, he tested the blood again. He found no sugar at all in the portal vein carrying the blood *to* the liver, but practically as much in the hepatic vein carrying the blood *from* it as before when under the carbohydrate diet. The liver evidently was a great sugar-making organ. But further researches, especially washing the liver after death, proved that it is not sugar *glucose* which is formed, but a starchy carbohydrate, to which, as its function is to make glucose by the ordinary transformation of starch into sugar, Bernard gave the name of glucose-maker, or *glycogen*. The liver stores up the starchy glycogen, and as the body requires it glycogen turns into the readily soluble glucose (grape-sugar), and as such gets burned up in the lungs. The liver obtains glycogen not only from starchy (amylaceous) foods, but from albuminous substances. In the latter case the albumen becomes glycogen and urea, the urea passing off by the kidneys.

Glycogen has the chemical formula $C_6H_{10}O_5$. It is best obtained from the liver of a freshly killed animal, cut into small pieces, and placed in boiling water for a short time, then bruised and boiled for a quarter of an hour. Alcohol now precipitates it as a white amorphous, starch-like substance, colourless, tasteless, odourless, soluble in water but not in alcohol; and readily passing into glucose (sugar) by the addition of any animal ferment or a dilute acid. Over-production of glycogen, and hence of glucose, leads to serious consequences; the surplus appearing as sugar in the urine (glycosuria) producing various diseases, among which is the well-known exhausting DIABETES.

It should be mentioned that lately a school has arisen, headed by the weighty authority of Pavy, which seriously doubts whether in life (healthy life) glycogen ever becomes sugar; whether, in fact, sugar is only the result of death or of disease decomposing the glycogen.

GLY'COL, or mono-ethylenic alcohol, is a diatomic alcohol, the name indicating that it is intermediate between glycerin, which is triatomic, and alcohol, which is monatomic. It is obtained by the distillation of acetate of ethylene with potash, and is a colourless, inodorous liquid, boiling at 197·5° C. (386° Fahr.) and having a specific gravity of 1·125. It is miscible with water and alcohol, but not with ether. The formula is $C_2H_6O_2$. Caustic potash is soluble in it, but the carbonate and sulphate are both insoluble.

GLY'COLLIC or **OXY-ACETIC ACID,** an acid obtained from the oxidation of glycol, and from several other sources. It is obtained in large crystals, having a very acid taste. The crystals melt at 78° C. (172° Fahr.) At 100° C. (212° Fahr.) the aqueous acid distils unchanged, but it decomposes at a higher temperature. It is soluble in water, alcohol, and ether. The formula is $C_2H_4O_3$. It is monobasic and diatomic, and forms an extensive series of salts with the metals and other bases, called *glycollates.*

GLYCYRRHI'ZIN, a saccharine principle found in the root of liquorice (*Glycyrrhiza glabra*), natural order Leguminosæ. It is obtained by precipitating the infusion of the root with sulphuric acid. The precipitate is well washed and redissolved in alcohol, from which it is recovered by evaporation. It is a sweet, amorphous, slightly yellow powder, soluble in water, alcohol, and ether. It is unfermentable. The formula is $C_{24}H_{36}O_9$. It is a glucoside, and is resolved on boiling with dilute sulphuric acid into glucose and glycyrretin ($C_{18}H_{26}O_4$). It is much used in medicine as a demulcent and gentle laxative.

GLYPT'ODON is a genus of large extinct animals belonging to the order BRUTA or Edentata, and finding their nearest allies at the present day in the little ARMADILLOS of South America. The Glyptodons are found in Pleistocene deposits in Brazil and Buenos Ayres. The name has reference to the longitudinally fluted character of their teeth. The body was covered with a complete armour of bony immovable plates, so that these animals could not roll themselves up like the armadillos. The head was short, the limbs stout, the feet short and broad, and the tail long. The head was protected by bony plates and could be retracted within the carapace of the body. The vertebral column had its segments so completely ankylosed as to form a cylindrical bony rod. *Glyptodon clavipes* measured over 9 feet from the snout to the tip of the tail. Many species of these huge extinct animals have been described. Recently the genus has been raised to the dignity of a family containing five genera.

GMELI'NA, an Asiatic genus of plants, belonging to the order VERBENACEÆ. All the species of Gmelina form shrubs or trees, of which the latter are valued for their timber. They are found in the islands of the Indian Ocean, extending thence into the Malayan and Indian peninsulas, China, and Australia. The leaves of *Gmelina parvifolia* are remarkable for rendering water very mucilaginous. *Gmelina arborea* is valuable for its timber, as it combines lightness with strength; the wood is not readily attacked by insects, and it is used for making carriages, chairs, &c. Gmelina is nearly allied to Vitex, but the stamens are shorter than the corolla, and the flowers are large, with a corolla-tube narrow below and wide above.

GNAPHA'LIUM, a genus of plants belonging to the order COMPOSITÆ. The species of this genus have a soft pubescent foliage with dry flowers, which keep for a long time without perishing, and, like those of some species of Helichrysum and Zeranthemum, are called "everlastings" or "immortal flowers." The species are numerous. Five are British. Several of the species of the old genus Gnaphalium are referred to new genera, as Antennaria and Filago. *Gnaphalium dioicum* is *Antennaria dioica* of Gærtner. It grows on mountain heaths in Great Britain, and is commonly called *cotton-weed*, and by the older herbalists *pes cati.* Its flowers are astringent, and were formerly employed in the cure of hooping-cough, phthisis, and hæmoptysis.

GNAT is the name given to the species of Culicidæ, a family of two-winged insects or DIPTERA, belonging to the section NEMOCERA. The Culicidæ are distinguished by

their long and slender proboscis, which is usually straight and projecting: in the female it consists of seven distinct pieces, the full number of the typical dipterous proboscis, and forms a powerful suctorial organ. The bloodthirsty tastes of the female are not shared by the male, who feeds on the juices of flowers and has a simpler proboscis. The maxillary palps are very long and hairy in the males. The males are also distinguished by the greater length and feathery appearance of their antennæ: these organs have fourteen joints. The abdomen is exceedingly slender and delicate; the thorax is stouter.

These insects pierce the skin by means of their proboscis, in order to feed upon the blood, and at the same time inject a poisonous fluid, producing considerable inflammation and swelling, which do not always readily subside. As examples we may mention the Common Gnat (*Culex pipiens*) and the mosquito (*Culex mosquito*). It is generally during the night or towards evening that the gnats emerge from their concealment and commence their life of activity. They abound alike in the regions of the north and in the hotter countries; and dreadful are the attacks of these armies of minute beings, details of which appear in the works of so many travellers, and are in fact sufficiently familiar to all. Gnats may often be seen dancing in the air in such numbers and so closely packed as to present the appearance of a cloud. The countless myriads in which these insects sometimes assemble may be realized in the story that a swarm of them appeared like smoke issuing from the spire of Salisbury Cathedral, causing an alarm of fire to be raised. The peculiar hovering of the gnats is caused by the extremely rapid motion of the wings, which, it has been calculated, vibrate 3000 times in a minute. Their rapidity of flight and keenness of vision is strikingly demonstrated in the fact that they escape unharmed in a shower, actually dodging the drops of rain. It is the rapid motion of the wings which produces the peculiar humming noise. The females deposit their eggs (which amount to 200 or 300) one by one, agglutinating them together so as to form a sort of raft, which floats on the surface of the water, in which element the larvæ exist and receive air (while floating head downwards) through a caudal or terminal tube. The pupæ also spend their existence in water, jerking themselves about by means of two paddle-like appendages to the abdomen; like the larvæ they breathe atmospheric air, but their breathing organs are two short tubes on the back of the thorax. During the emergence of the perfect insect the pupa case remains floating on the surface of the water, forming a resting-place for the gnat till its wings are ready for flight. The species of the family Culicidæ are numerous, and world-wide in their distribution. The common gnat is *Culex pipiens*. Several species of the same genus Culex, under the name mosquitoes, are the scourges of hot climates.

GNEISS is a crystalline rock having a foliated structure and of metamorphic origin. It is typically composed of an aggregate of the same minerals as granite, viz. quartz, felspar, and mica. These constituents are arranged in layers; but in many cases metamorphism has proceeded so far as to obliterate the parallel structure, so that in some areas of metamorphic crystalline rocks the hand-specimens are undistinguishable from granite, the rock being in fact a "bedded granite." The beds are often many feet in thickness, and separated from each other by comparatively unaltered schists, or even by crystalline limestone in which the original blue colour (due to organic matter) has not been destroyed. From this it is evident that the original composition of the rock just as largely affects the amount of subsequent change as it does the ultimate minerals developed.

As wide limits are given to the use of the term gneiss structurally, so in the actual mineral constitution of the rock there is considerable variation. Many varieties are recognized, corresponding in a great measure with similar deviations from the normal granite type; they may be regarded as due either to the addition of new minerals or to the replacement in whole or in part of one or more of its typical constituents. Thus there is *oligoclase gneiss*, in which the triclinic felspar is accessory or replaces some of the orthoclase; *hornblendic gneiss*, where the hornblende replaces some of the mica; *Syenitic gneiss*, where it replaces the whole of it and quartz is absent. In some instances this rock very nearly approaches diorite when the felspar is plagioclase. In the variety *protogine gneiss*, which is largely developed in the Alps, in addition to the ordinary constituents there is a greenish pearly mineral, probably talc.

As gneiss is a metamorphic rock it occurs in formations of almost any age, but is more abundant in the older series and those which have been subjected to much alteration. Gneiss is sometimes confined to a narrow belt along the bounds of some eruptive mass; it is then only a product of *local metamorphism*. More usually it is found occupying a large area, and although much twisted and folded a prevailing general strike and dip can be usually recognized. In such a case the metamorphism has been regional, often extending through a whole formation, but usually more intense in one portion than another. It was formerly supposed that this crystalline stratified rock was a peculiar formation, which was called Primitive or Primary, a deposit formed from the waste of granite in a highly heated ocean. The theory has long since been abandoned, as crystalline metamorphic rocks are not uncommon throughout the geological series, which could not be if they were only formed during the period immediately succeeding the consolidation of the surface of the earth.

Of the areas of gneiss in the British Isles, one of the most remarkable and interesting is that of the fundamental gneiss of Scotland. These rocks, considered to be equivalent to the LAURENTIAN ROCKS of Canada, are exposed in the north-west of Ross and Sutherlandshire and in the island of Lewis. They strike north-west and south-east, and are succeeded unconformably by Cambrian and other formations that strike nearly at right angles to the underlying series. The gneiss of Donegal and the west coast of Ireland is considered by some geologists to be a continuation of these old rocks; there are, however, many points of difference, among them the fact that the strike and dip of the gneiss of Donegal are conformable with those of the overlying less altered formation. On this subject there is, however, much diversity of opinion.

GNE'SEN (Pol. *Gniezno*), a town of Prussia, in the province of Posen, 30 miles E.N.E. from the city of that name. The population is 13,826. It is inclosed by walls, and has a cathedral, several other Roman Catholic churches, convents, and a diocesan school, it being the see of the archbishop-primate of Prussian Poland. There are also several breweries and distilleries. Gnesen is said to be the oldest town of Poland, and was the capital until 1320.

GNETA'CEÆ, an order of plants belonging to the subclass of GYMNOSPERMS. The species of this family are natives of the temperate parts of Europe, Asia, and South America. Gnetum is an inhabitant of the hottest parts of India and Guiana. Some of the species of Gnetum are used as food. The seeds of *Gnetum Gnemon* are eaten in Amboyna, and are roasted, boiled, or fried. The green leaves are cooked and eaten like spinach. The inside of the fruit of *Gnetum Thoa* is lined with stinging hairs; the seeds are, however, eaten. The stem exudes a transparent gum, and when cut across yields a large quantity of transparent water, which is used for drinking. For the flowers of Gnetum, see BOTANY, Plate II., figs. 2 and 2*a*. The only other genera are EPHEDRA and Welwitschia. See article BOTANY for the characteristics of the order.

GNOME (Gr. *gnōmon*, an interpreter), an imaginary being supposed to inhabit the interior of the earth. The Cabalists of old represented them as of small stature, and friendly to man. The gnomes were supposed to be the guardians of mines and concealed treasure. Vigenere calls them *gnomons*. [See also ELFS and DWARFS.] It will be remembered that Pope uses them as part of the spiritual machinery in his unrivalled "Rape of the Lock." In the preface he distinguishes the spirits of air, water, fire, and earth as sylphs, nymphs, salamanders, and gnomes, representing the latter as full of mischief. The gnomes are the "black elves" of German mythology.

GNO'MIC POETS OF GREECE are those moral and philosophical poets whose remains consist chiefly of short sententious precepts or reflections. Such are the Gnomæ of Theognis, which, though numbered consecutively as a connected poem to 1200 lines, form in fact a collection of unconnected members, varying from two to thirty lines in length. This notion of a pithy saying, or apothegm, is one of the meanings of *gnōmē*. These poets have been edited by Brunck. The principal authors contained in this edition are Theognis, Tyrtæus, Solon, Simonides, with many others, some to the extent only of a few lines. Brunck's edition contains also a collection of Gnomæ from the comic writers. The Gnomic writers are sometimes classed under the general name of Elegiac Poets.

GNO'MON (Greek *gnōmon*), or style of a dial, is the plate which projects from the surface of the dial-plate, the edge of its shade determining the hour-line. In geometry a gnomon is a figure composed of two rectangles with one angle common to both, a figure like a carpenter's "square" or like a letter L. The gnomon of the dial being at first of this shape thus got its name.

GNOMON'IC PROJECTION. See MAPS and MAP-MAKING.

GNOS'TICISM (from the Greek *gnōsis*, knowledge) is a term used to designate various forms of speculation that arose in connection with the early history of the Christian church. In the Septuagint the word *gnosis* is used to denote the true knowledge of God, while it is used in the Epistles to describe a saving knowledge of Christ, and it seems probable that the term gnostic was applied in the first instance in a favourable sense, to designate one who was spiritually enlightened. In the second century, however, it was adopted by some of the sects who propounded systems of theology opposed to the orthodox belief; hence the term is used by patristic writers to distinguish the disciples of those who were adverse to the church. The period which immediately preceded the introduction of Christianity was one that was peculiarly favourable to the rise and development of religious speculation. The Roman Empire extended throughout nearly the whole of the civilized world, and this brought about a freedom of intercourse between different nations such as had never before existed. The system of the Buddhists of India, the dualism of Persia, the esoteric doctrines of the priests of Egypt, the philosophy of Greece, and the old and new forms of Judaism were brought into contact with each other, with the result that old national systems of religion lost their hold upon intelligent men, and a ferment of inquiry for a true system arose among them. The advent of Christianity and the rapid spread of its influence in Asia and Europe added a new element to the influences already at work, hence arose a number of sects who sought to combine some of the ideas derived from older systems of religious belief with the new ideas of the gospel. Much controversy has arisen as to whether the system of gnosticism had attained to any definite form during the apostolic period, and whether there is any reference to them to be found in the New Testament. It is certain that allusions are to be found in the later epistles of Paul to various tendencies of thought which afterwards became identified with gnostic schools, and the same may be said of the fourth Gospel and the Apocalypse. The latter is generally thought also to refer to one of these sects by name in the allusions to the Nicolaitans, a sect supposed, on slender authority, to derive its name from Nicolas, one of the seven deacons who had fallen away from the faith. But it seems also certain that while the tendencies which afterwards led to the formation of the systems of gnosticism existed in the apostolic period, they did not attain to full development until the second and third centuries after Christ. Gnosticism included many sects that differed considerably from each other, and it is difficult to give an account of their opinions that will apply equally to all. The matter is also rendered more obscure from the circumstance that we are indebted for our knowledge of gnosticism to the writings of its Jewish and Christian opponents, writers with whom impartiality was hardly a strong point. There appear, however, to have been three great schools of gnosticism, one having Antioch in Syria for its centre, and the others Alexandria and Asia Minor. By many of the fathers Simon Magus is regarded as the first individual who propagated gnostic opinions, but he is more celebrated as a magician than as a teacher, and it is to his pupil Menander, who settled at Antioch, that the foundation of the Syrian school is to be attributed. Its chief representatives are to be found in Saturninus of Antioch, Bardesanes of Edessa, and Tatian of Rome, a pupil of Justin Martyr. The larger and more important school of Alexandria appears to have been founded by Basilides, a native of Syria, who taught there between the years 125 and 140 A.D. Its most celebrated teacher was Valentinus, who went to Rome about 140, and died there in 160. His system was one of the most elaborate and closely reasoned of all that arose, and it continued in existence for over 300 years. The chief of the gnostics of Asia Minor is to be found in Marcion, who flourished about the middle of the second century. He is said to have been the son of a Christian bishop, and is distinguished by his hostility to Judaism and his rejection of a large portion of the New Testament.

Among the notions that were common to the majority of the gnostics were those relating to the Divine Being, by which he was regarded as being beyond conception and description, but also as supremely perfect and infinite in his attributes. They considered it to be beneath the might of the Supreme Deity to labour, and therefore maintained that he had not created the world. Moreover they contended that, seeing there was much evil existing in the visible world, it was impossible that it could be the work of an all-perfect God. They believed that God dwelt in a *plērōma* of inaccessible light, but that from him there proceeded certain emanations or spiritual powers. These emanations or Æons were believed to gradually descend in degree, until they reached the lowest in the form of the Demiurgus (Gr. *dēmiourgos*), who was the creator of the visible world, and was by some of the gnostics identified with the Jehovah of the Old Testament.

They also taught that Christ was one of the Æons of higher rank than the Demiurgus, and was sent into the world to restore men to the knowledge of the true God; and that the Æon Christ descended into the man Jesus at his baptism, and left him when he was led to crucifixion, so that the man Jesus alone suffered. They accepted the idea of redemption or salvation, but did not believe it extended to all, but only to a certain select number of spiritually-minded men. There were, however, a considerable number of gnostics who maintained that the Demiurgus or world-creator was a power in antagonism to the Supreme Deity, and professed to see proofs of his base, cruel, and limited disposition, not only in nature, but also in the Old Testament, which was considered to be peculiarly his work. Others went so far as to invert the whole of the Old Testament story altogether. They regarded the serpent who tempted

Eve as being in some way a symbol of creative and redeeming power, considered Cain to be the primeval representative of *gnōsis*, and received all the evil characters depicted in the Old Testament, and Judas Iscariot in the New, as the spiritual heroes of gnosticism.

In its practical influence upon life gnosticism seems to have promoted, in some of its forms, a rigid austerity and stern self-denial, while in others it encouraged licentiousness and sensuality.

The influence of these various sects seems to have generally declined towards the close of the third century, but they maintained a lingering existence for a long period, and some of their distinctive doctrines have several times reappeared in the history of mediæval Christianity. See also AGNOSTICS.

GNU (Catoblepas) is an aberrant genus of ANTELOPES confined to South Africa. The gnus present a most grotesque appearance. With the shaggy broad head of a buffalo they unite the body and hind quarters of a small horse and the slender limbs of the common antelopes. The Common Gnu (*Catoblepas gnu*) stands about 4½ feet high at the shoulder, and is 9 feet in length. The muzzle is large, bristly, broad, and square-shaped, the nostrils being furnished with a muscular valve. The horns, which are present in both sexes, are wide at the base, where they expand into a broad protecting plate on the forehead; from this point they are directed downwards and slightly outwards over the eyes, and then, making a regular curve upwards, terminate in a sharp hooked extremity. The chin is furnished with a thick beard, similar tufts of black hair being situated below the eyes. A flowing whitish mane extends along the neck, from the occiput backwards to a point beyond the withers. The ears are comparatively small. The tail resembles that of a horse, has a white colour, and reaches to the ground. The space between the fore legs is covered with thick shaggy black hair. The general colour of the fur is that of an umber-brown, passing into brownish-black. The limbs are particularly slender, terminating in bluish-black hoofs, which are pointed and compressed anteriorly. The habits of the gnus are gregarious, and they are exceedingly wild and swift of foot, following one another in single file, and skimming the plains with extraordinary velocity; they are extremely restless, seldom remaining long at one spot, and migrating

The Brindled Gnu (*Catoblepas gorgon*).

from place to place in vast herds. Despite their fantastic appearance, when seen at a considerable distance they are said to look extremely like lions, while the snort of the old males is an excellent imitation of the roar of the king of beasts. The female gnu usually produces a solitary calf at a birth, which at first exhibits a whitish cream-coloured fur, subsequently becoming reddish-gray. The flesh of the adult is coarse, but that of the calf is considered excellent. The tail is used for making chowries, while the hide is brayed and converted into thongs; in this state it is chiefly employed as harness, being also applied to other economic uses as a substitute for rope or twine.

The Brindled Gnu (*Catoblepas gorgon*) is readily distinguished from the common species by its arched face, laterally directed horns, deep bluish-black hide striped with obscure vertical bands, absence of any tufts of hair between the fore legs, and immensely thick, elevated and powerful shoulders (see cut). The body measures 9 feet in length, including the tail and head, the latter alone being 23 inches from the tip of the muzzle to the occipital crest. The brindled gnu inhabits the plains of Southern Africa to the north of the Orange River. The flesh of the brindled gnu resembles beef and is eaten by the natives. The hide is dressed with the mane and beard attached, and is converted into cloaks, &c.

GO'A. A Portuguese settlement on the Malabar or western coast of India, lying about 250 miles south-south-east from Bombay. The extreme length from north to south is 62 miles, and the greatest breadth from east to west 40 miles. The total area is 1062 square miles, population about 400,000. Goa forms a patch of foreign territory on the coast of the Bombay coast, and is surrounded on all sides, except to the seaward, by British districts. It is a hilly country, and is intersected by numerous rivers, which are generally navigable. The staple produce of the country is rice, of which there are two harvests, (1) the winter crop, called *sorodio*, and (2) the summer crop or *vangana*, raised by means of artificial irrigation from the rain-water accumulated in reservoirs. The territory possesses a harbour formed by the promontories of Bardes and Salsette. The annual

rainfall averages 100 inches. The prevailing diseases are intermittent and remittent fevers, diarrhœa, and dysentery. The inhabitants are divided into three classes—(1) Europeans, (2) the descendants of Europeans, and (3) natives. The last class may be again divided into Christians and Pagans. The native Christians, who constitute about two-thirds of the total population, are the descendants of Hindus converted to Christianity on the subjugation of the country by the Portuguese. The majority of the population profess the Roman Catholic religion, and are subject in spiritual matters to an archbishop, who has the title of the Primate of the East, and exercises jurisdiction over the Catholics of all the Portuguese colonies in the East and of a great portion of British India. His nomination rests with the King of Portugal, subject to confirmation by the pope.

At the conquest of Goa by Alfonso de Albuquerque in 1510, the village communities, among which the inhabitants were distributed, were found to be in the enjoyment of certain immunities from taxation and other privileges. Albuquerque carefully maintained the constitution of these village communities, and avoided all appearance of fresh taxation.

New Goa, the present capital, comprehends Panjim, Ribandar, as well as the old city of Goa, and is 6 miles in extent. It is situated on the left bank of the river Mandavi, at a distance of about 3 miles from its mouth. As in the case of Bombay city, the surface has been gradually formed by filling up hollows and reclaiming large tracts of marshy land. The present population is returned at 14,134 persons, dwelling in 3850 houses. In the days of its glory Goa was the chief entrepôt of commerce between the East and West. But with the downfall of the Portuguese Empire it lost its commercial importance, and its trade has now dwindled into insignificance. Few manufacturing industries of any importance exist, but the country is not devoid of skilful artisans, such as goldsmiths, carpenters, blacksmiths, shoemakers, &c.

Old Goa, situated about 5 miles to the north of the Hindu capital, was built by the Mohammedans in 1479, nineteen years before the arrival of Vasco da Gama in India. This famous city, conquered by Albuquerque in 1510, became the capital of the Portuguese Empire in Asia. As such it was once the chief emporium of commerce between the East and West, and enjoyed the same privileges as the city of Lisbon. It reached the climax of its splendour during the sixteenth century; but with the decline of the Portuguese power in the following century, it began gradually to lose its significance in every respect, save as an ecclesiastical metropolis. The frequent plagues by which the population was repeatedly thinned, together with the removal of the seat of government to Panjim, and the suppression of the religious orders, contributed finally to effect its complete downfall. Instead of the 200,000 inhabitants which once formed its population, hardly 100 poverty-stricken creatures remain to haunt the ponds and wells.

GOAT (Capra) is a genus of horned ruminants so closely allied to the sheep (Ovis) that according to some these animals cannot be generically distinguished. Each has persistent horns in both sexes. The goats are characterized chiefly by their long horns, which are directed upwards and backwards, are more or less angular in front, rounded behind, and generally marked by transverse bars or ridges. The sheep, on the other hand, have the horns more uniformly cylindrical, directed at first backwards and subsequently bent spirally forward. The goats have usually a beard on their chin, but they lack in most cases the interdigital pits which the sheep possess—small pits between the toes, producing a fatty secretion. The rank odour emitted by the male goat is another distinction. The tail of the goat is shorter than in the sheep. The chief wild species of goat, *Capra ægagrus* (ÆGAGRE) and *Capra ibex* (IBEX), are noticed elsewhere. We have to consider the domestic goat and the varieties to which it has given rise.

The goat affords another example of the uncertainty which clouds the history of our domestic animals; "most naturalists now believe that all our goats are descended from the *Capra ægagrus* of the mountains of Asia, possibly mingled with the allied Indian species *Capra Falconeri* of India" (Darwin). The goat has been domesticated from prehistoric times. Its boldness and agility have become proverbial. It is very hardy, enduring both heat and cold well. "No animal," says Pennant, "seems so subject to varieties (the dog excepted) as the goat;" nor did its multitudinous transfigurations escape Pliny (lib. viii. c. 53). The domestic goat (*Capra hircus*), varies infinitely in

Tibet Goat, or Cashmere Goat.

stature, colour, length, and fineness of the hair, and in the size, and even in the number of horns. The goats of Angora, in Cappadocia, with their soft and silky hair, and those of Tibet, the delicate wool of which grows among the long hair, and is manufactured into the shawls (CASHMERE) so highly prized, are peculiar varieties. The Angora goat, which inhabits the tract that surrounds Angora and Beibazar, in Asiatic Turkey, where the goatherds bestow much care on their flocks, frequently combing and washing them, loses, it appears, the delicacy of its hairy covering when exposed to a change of climate and pasture. Attempts have been made to acclimatize the Cashmere goat in England, but these have not met with much success.

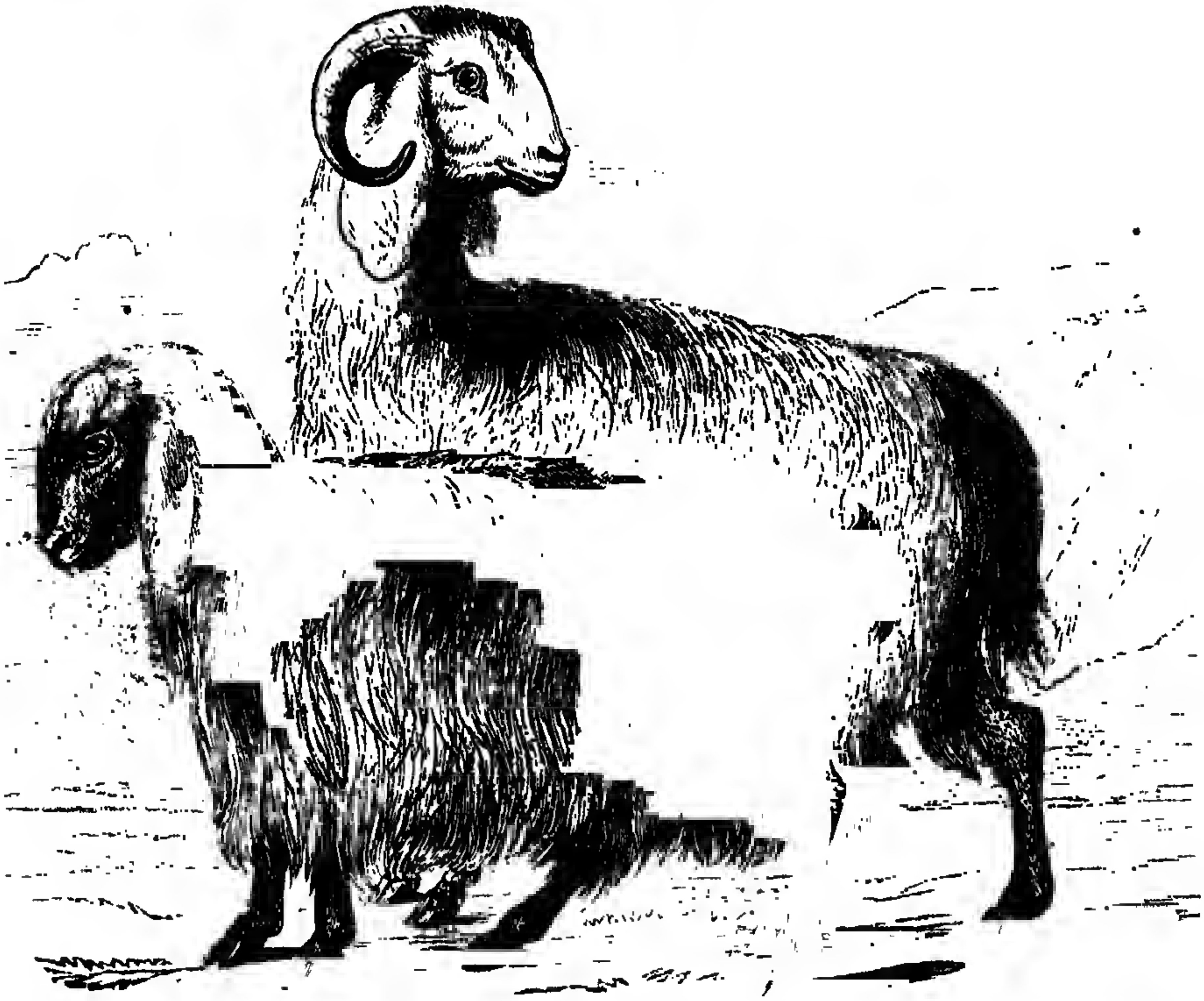
The Syrian Goat, with its excessively long ears and hair (see cut), which is plentiful in the East, is worthy of special notice. The Maltese Goat has very long pendulous ears. The horns are frequently entirely absent. The Nubian Goat, from Nubia, Egypt, and Abyssinia, has only recently been known in the west of Europe; as a milch goat it is extremely valuable. This goat has long legs, very short, twisted, black horns, and very short hair. The Dwarf Goat is a beautiful little variety from the coast of Guinea.

That the goat and sheep will interbreed is a fact sufficiently attested. Hybrids between the common goat and the ægagre, and the common goat and the ibex, also occur, but are rarely fertile.

The goat is very useful to man. These animals can be kept in situations which would be unfavourable to sheep. Marshy grounds should, however, be avoided. They breed usually once a year, the female after a period of five months' gestation generally producing two kids at a birth. The milk resembles that of the cow in taste, and an ordinary goat will yield about 3 pints a day. The flesh of the adult goat is eatable, but that of the kid is very delicate. The skin is dressed as leather and used for making gloves, ladies' boots, &c. The hair is used for making ropes, lawyers' wigs, &c.

Goat's flesh as food is stronger both in flavour and in

power-giving qualities than mutton. The traveller in Switzerland is not unfrequently regaled with it; sometimes it is passed off upon him as chamois (*gemsfleisch*). It is harder and tougher than mutton, and is sometimes far too rank in taste for refined tastes. At other times, if the animal was young and well-fed, it is not unpalatable.



rian Goats (*Capra hircus*, var. Mambrica).

Properly "hung" the flesh of the kid makes an excellent substitute for venison. The tale of Jacob and Isaac shows the favourite character of the meat at the early time described in the opening book of the Old Testament.

GOAT-MOTH (*Cossus ligniperda*) is one of the largest British MOTHS, belonging to the family Hepialidæ. The body is thick, the head very small, and the antennæ long and rather slender. It measures about 3 inches across the expanded wings. It is of a gray colour; the fore wings are mottled with white and marked with many irregular black transverse lines; the hind wings are brownish. The caterpillar emits a very strong and disagreeable odour, rivalling in rankness that of the male goat (whence the common name). It lives in trees, especially poplars and willows, forming large cavities in the trunks, and feeding upon the wood. It is three years before attaining its full growth, at which time it incloses itself in a tough cocoon. The goat-moth is common in the south of England.

GOAT'S-BEARD. See SALSAFY.

GOATSUCKER is the name applied in almost all languages, from the times of the Greeks and the Romans downwards, to a bird suspected of sucking the milk of goats and other domestic animals. This suspicion is quite unwarrantable. The goatsuckers indeed frequent the folds in which goats and sheep are penned for the night, but they are attracted thither by the numerous insects to be found in such places.

The Common Goatsucker (*Caprimulgus europæus*) is the type of a very distinct family of VULTORES, Caprimulgidæ.

Goatsuckers are crepuscular and nocturnal in their habits; they pass the hours of day in repose, shrouding themselves from observation in the gloom of woods, or amid the dense foliage of trees, coming forth at evening to feed upon such insects as, like themselves, are roused on the advance of darkness. They take their prey upon the wing, and perform during the chase the most elegant aërial evolutions. Their eyes are large, and of the true nocturnal character; the beak is sometimes small, sometimes inflated, but the gape is always enormous, extending below the eyes, and reminding one of the mouth of a toad; its margin is fringed with strong bristles; the wings are long and pointed; the tarsi usually very short; the hind toe is in some genera united close to the base of the inner toe, and directed almost as equally forwards; the middle of the three anterior toes is the longest, and in the more typical forms is armed with a long claw, having a comb-like or pectinated inner margin.

The plumage is full and soft, and beautifully variegated with dots, bars, dashes, and zigzag marks of mingled gray, brown, fawn-colour, black, and white, difficult to describe, and almost as difficult to imitate. Rapid and abrupt as is the flight of these birds, still it is noiseless, resembling in that respect the flight of the owl, and from the same cause—viz. the laxity and want of rigidity in the quill feathers; but from the form of the wing and tail the flight is of a different character.

The Common Goatsucker (*Caprimulgus europæus*) is a bird of passage, retiring in the autumn to the warm regions of the south from the colder and temperate countries of Europe and Northern Asia. It is one of the latest of our migrating birds, arriving in this country about the middle of May; it usually departs again at the end of August or the early part of September.

The common goatsucker measures about 10 or 11 inches in length, including the tail, which is rather long. The

Common Goatsucker (*Caprimulgus europæus*).

plumage is dusky in its general tint, presenting when closely examined a mixture of gray, red, and brown; but the whole of the upper parts are streaked and spotted with blackish-brown, and the tints of the lower surface are arranged so as to form a series of alternately dark and light undulated bars. The eyes are dark and very beautiful. The note of the bird, which is only emitted by the male, is a sort of whirring sound, compared by many writers to the noise made by a spinning-wheel; hence he is known as the wheel-bird in some districts, and in others as the night-jar (a very common English name), night-churr, and churn-owl. The goatsucker is also called dor-hawk for its liking for dor-beetles, and fern-owl because it lik to take up its abode in fern brakes.

The eggs of the goatsucker are usually two in number, of a white colour, clouded with bluish-gray. They ar deposited in a depression or cavity on the surface of th ground, under the shelter of a bush, generally with scarcely any attempt at a nest. In this country the eggs ar deposited about the first week in June.

The habits of other species of the genus, and indeed o the whole family, are very similar to those of the commor goatsucker. Two American species of a nearly allied genus, Antrostomus, have very remarkable notes, which give then their common names—Chuck-Will's-widow (*Antros tomus carolinensis*) and Whip-poor-Will (*Antrostomu vociferus*). An African species, *Macrodipteryx longi pennis*, is remarkable for the extraordinary developmen in the male of the ninth primary of each wing; the feathe measures sometimes twice the length of the body, but i furnished with barbs only at the extremity, the remaind of the feather constituting a bare shaft. The Night-haw of North America (*Chordeiles virginianus*) also belong to this family. In this species the gape is destitute o bristles. The genus Podargus, with a few allie genera, is sufficiently distinct from the preceding specie to form a subfamily, or according to some a separate family The curious Guacharo, or Oil-Bird of Trinidad, formin the genus Steatornis, is now separated from the goatsuckers, with which it was formerly associated.

GOB'BO. See Hibiscus.

GOB'ELIN, the name of a celebrated family wh introduced from Venice into France, in the reign 'rancis I., the art of dyeing scarlet, and established xtensive workshops for the purpose upon the small river ièvres, in the Faubourg St. Marcel of Paris, at Gentilly. Iere the brook takes the name Gobelins from the manuactory. In the year 1677 Colbert purchased the dyeouses from the Gobelin family; in virtue of an edict f Louis XIV., he styled it the Hôtel Royal des Gobelins, nd established on the ground a great manufactory of apestry, similar to that of Flanders. The celebrated ainter Le Brun was appointed director-in-chief of the veaving and dyeing patterns. Under his administration vere produced many magnificent pieces of tapestry, which ave ever since been greatly admired. The manufacture s still carried on in the same place, at the national exense, carpet weaving as well as tapestry weaving being xecuted on a large scale. It still remains one of the sights f Paris. As the workmen fancied the dyeing of the silks and wools was not so brilliant as in former years, the hemist Chevreul was induced in 1825 to undertake an investigation into the matter. The result was his splendid heory of the interaction of colours with one another. He clearly showed that not the dyer, but the designer and weaver were at fault; brilliant colours were not sufficient, hey must be suitably arranged. He proved to demonstraion that a dull colour can be made bright by the effect upon it of skilfully-selected neighbouring tints, and that the brightest hue can be dulled by the proximity of tints which injure it. He succeeded in formulating these colourharmonies, and in restoring the confidence of the artists of the Gobelins, who, by attending to the conclusions of the philosopher, excelled in brilliancy all previous effects. The renown of the Gobelins, both by the investigation and its results, stands higher than ever. See Colour.

GO'BI or SHAMO, for which formerly the less correct expression *Cobi* was used, is a Mongolian term signifying "desert," and is employed to indicate the immense tract of desert country which occupies nearly the middle of the high table-land of eastern Asia, and extends from the neighbourhood of Yarkand and Khotan, or from about 75° E. lon. on the west, to the Kingkhan Oola, or about 115° E. lon. on the east. But a portion of this desert extends east of the Kingkhan Oola to the northern boundary of the Chinese province of Leao-tong, more than five degrees further east. Its latitude is between 35° and 45° N.; on the west it is nearer to 35°, and on the east nearer to 45°. Its mean width may be between 350 and 400 miles, and its length perhaps not less than 1800 miles. It is for the most part an exceedingly sterile wilderness, consisting of loose sand, bare rock and shingle, alternating with firm sand scantily clothed with vegetation. But a large portion, while equally treeless and monotonous, seasonably assumes the aspect of an ocean of grass, and supplies pasturage to the flocks and herds of the pastoral tribes, whose camps, like moving cities, make the tour of the vast prairie grounds.

The climate of the Gobi is extremely cold. The winter lasts more than nine months; even in July and August snow falls, and it frequently freezes. The Eastern Gobi is occupied by different tribes of the Mongolian race, who have numerous herds of camels (but only the Bactrian), horses, and sheep; in the more mountainous districts there are also black cattle, but they are not numerous. In the Western Gobi are some nomadic tribes of the Turkish Tartar race.

GOB'LINS, called also *Bogles* (in German *kobold*, and in French *gobelin*), are demons of popular superstition, the belief in which has existed in most countries from the earliest times. Some have derived the words elf and goblin from Guelfs and Ghibellines, the names of two great political parties which divided Italy and Germany during the middle ages; but the true derivation of *goblin* as well as of *kobold* is from the Low Latin *cobalus*, Greek *kobalos*, a rogue, an imp. The metal cobalt, once thought

an acrid poison, gets its name from the same root. [See ELF, DWARFS.] Hobgoblin, no doubt a corruption of hopgoblin, is often substituted.

GO'BY (Gobius), a genus of fishes, the type of the Gobiidæ, a family of ACANTHOPTERYGII. All the species have two dorsal fins, scaly bodies, and a disc beneath the throat formed by the united ventral fins. By means of this disc they have the power of attaching themselves to rocks. Several species of goby are met with on the British coast. The largest is the *Gobius niger*, which attains the length of 6 inches, and ranges from Cornwall to the Orkneys. Mr. Couch has inquired into the habits of the black goby, and finds that when it has seized its prey it carries it off alive in its month to its resting-place, which is among rocks. The other British gobies (*Gobius paganellus, Gobius minutus, Gobius auratus*) are mostly inhabitants of sandy ground. On the shores of the Mediterranean gobies abound, and are also found in deep water, even to a depth of 50 fathoms. The deep-water species are distinct from those frequenting the coast-line. Nearly 300 species of this genus have been described, abounding especially on tropical coasts. Many have been acclimatized in lakes and other fresh waters.

The species of Gobius are very tenacious of life, and are capable, like their neighbours the blennies, of living some time out of water. The most remarkable fact connected with the history of these fishes is their nidification. That the goby built a nest was known to the ancient Greeks. This nest they construct in spring of sea-weeds, &c., and in it the female deposits her eggs, while the male watches over them until they are hatched. The nest of the goby is very well built, and has of late been observed on our own coasts. Several other genera closely allied to Gobius have been described. One species, *Latrunculus pellucidus*, found in the south of Scotland and some other parts of Europe, having a very small transparent body, is remarkable for living one year only, all the adults dying in July and August, and the eggs being hatched in the latter month. The DRAGONETS (Callionymus) also belong to the family Gobiidæ.

GOD, one of the names given to the infinite, eternal, self-existent, all-supreme Being, the author and sustainer of the universe. This name is derived from the Saxon *good;* and it corresponds with the Greek *Theos*, the Latin *Deus*, whence the French *Dieu* and Spanish *Dios*, and the German *Gott*. In the Hebrew Scriptures the names chiefly used are *Elohim* (God), a word of uncertain derivation, but containing the idea of strength and awfulness (often translated The Dredded One), and an unknown word represented by *Yahăveh* (Jehovah), commonly said to mean "I am" (Being), but more probably containing the idea of creation. (See JEHOVAH.) The latter name was regarded with peculiar veneration, its pronunciation was preserved as a secret and has long been lost, the term *Adonai*, Lord, or My Lords, being substituted in the public reading of the law. An abbreviated form of the name Jehovah, Jah, is used in Hebrew poetry, and other titles, such as *El-Shaddai*, God Almighty; *El-Elyon*, the most High God; and *El-Sabaoth*, the God of Hosts, are sometimes used. Terms corresponding to some extent with those indicated could probably be found in every human language, for the belief in the existence of a spiritual power, or of powers superior to man, but having an influence over him, is at once one of the most ancient and most widely spread of all human conceptions.

The earliest traditions that have been preserved of the primitive history of the human race are full of references to the gods, and some of the oldest root-words that have been traced out by comparative philology are names given to the spiritual or unseen powers worshipped. The interesting fact has also been pointed out by Professor Max Müller, that one of the most ancient Aryan names is one that is in general use at the present day. The statement of Cicero that there was no nation so degraded as not to have a belief in some divinity has occasionally been questioned by modern travellers, but there can be little doubt as to its general truth. The question as to what element it is in human nature which forms the basis of this belief has often been debated and variously answered by philosophers and theologians. Some of the answers given it is unnecessary to refer to, but of those which have obtained acceptance among thoughtful men the theories which find the answer in the sense of dependence, in the sense of wonder, and in the consciousness of the infinite, may be mentioned; for although neither theory has obtained general acceptance, each has received the support of men of eminence in the history of philosophy. An entirely different theory, which traces the origin of man's conception of a deity to his faculty of dreaming during sleep, and which is known as the ghost theory, has been propounded by Mr. Herbert Spencer, who has collected and marshalled a series of curious and interesting facts both from primitive history and modern savage life in its support.

Passing from the questions concerning the origin of this conception to its history, we find that the mind of man has passed through many stages between the first and lowest ideas of fetichism and the spiritual conception of the God of infinite power and love, whose attributes are set forth in the system of Christianity. There is very much that is obscure and unknown in connection with the early history of the human race, and despite many brilliant theories upon the subject the real light of science only shows at present the greatness of the existing darkness. Hence all theories as to the origin, rise, and progress of the human knowledge of God must be received with caution, for there is not enough positive knowledge to form any adequate basis for them. Bearing this caution in mind we may observe that the stages generally marked by investigators are those of fetichism, polytheism, dualism, pantheism, and, lastly, monotheism. It is not supposed that every nation or even race that has now attained to the last-named conception has passed through all these stages, but that these ideas correspond to distinct degrees of civilization. At present there are in the world nations or peoples whose ideas concerning God correspond to each of the conditions named, and the intelligent study of their theologies serves to throw much light upon the history of nations which have long passed away. In the written histories of many of the ancient races the change from the primitive fetichism, with its adoration of rocks, meteoric stones, beasts, insects, trees, the heavenly bodies, the forces of nature, &c., to polytheism, or the worship of many gods, and the decay of the latter before the growing knowledge of the unity that pervades all things, can be clearly traced, and this is especially the case with the nations of Greece, Rome, and India. Probably in the case of each nation the more lofty and spiritual truths were perceived only by the finer spirits of the nation; and thus, while some adored a deity unseen, spiritual, and pre eminent, the majority were content with the belief in many gods, or paid devotion to some tangible object that excited the emotions of wonder or fear. Certainly at the present day it is easy to discern that though all who profess Christianity accept a monotheistic faith, large numbers of its adherents are in reality polytheists, while traces of fetichism abound on all sides, even in nations the most civilized and cultivated.

Turning to the consideration of the arguments advanced by theologians in support of theism, it has been observed as a fact that the *idea* or *presentiment* of God is almost everywhere rooted in the mind of man. This has been observed by the philosophers of all nations, is confirmed by the inquiries of travellers, and it forms one of the most obvious facts of our daily experience. In reference to this intuition a thoughtful modern apologist of Christianity has

observed, "This instinctive perception and affirmation of God is not merely an act of the intellect; it is also, perhaps chiefly, an act of the moral sense, an act of conscience. It is that upward attraction of the soul upon which Plato dilates; it is the universal hypothesis which Aristotle registers; it is the world-wide prejudice of Epicurus; it is the 'anticipation' naturally embedded in the human mind of Cicero. It precedes demonstration; it is out of the reach of criticism; it resists hostile argument. It is, speaking philosophically, a fact in psychological science, and a fact so fruitful and stimulating that to it must be traced all in human life and effort that looks really upward." Another writer of an entirely different school, speaking of this intuition, says, "It depends primarily on no argument whatever; not on *reasoning* but *reason*. The fact is given outright, as it were, and comes to the man as soon and as naturally as the consciousness of his own existence, and is indeed logically inseparable from it." Starting from this point, or at least assuming its existence, several trains of reasoning have been traced out which lead up to conceptions of God. The most important of these are such as are derived from the contemplation of nature, the law of causation, and the moral nature of man. In respect to the first of these arguments—viz. that which proceeds from effects upward to their cause—scientific investigation has proved that there are everywhere throughout the world traces of order, and that there is a principle of unity pervading the whole of physical nature open to the mind of man. Further, whatever part of the universe is considered, there can be traced the working of forces which carry evidences of the adaptation of means to ends, of what in human affairs are termed design and arrangement, while the infinite magnitude and complexity of these forces and their operations bring about the conviction that they result from a power and wisdom that are infinite. Closely connected with these considerations, and indeed forming an essential part of them, is the argument derived from causation. The conviction that for every effect there must exist a corresponding cause seems to be an original and essential law of our intelligence. Some attempts have been made by philosophers of modern times to reduce causation to merely antecedence, but it is a law too deeply ingrained in human thought to be greatly disturbed by any number of metaphysical arguments. Reasoning in accordance with this law the mind is led upward from the consideration of secondary causes to the great first cause, itself uncaused, and to find it in a Being of infinite power and wisdom.

These arguments, though valuable, fruitful, and interesting, are generally admitted to be inadequate to *demonstrate* the existence of God by themselves, and their insufficiency has been more clearly pointed out by Kant than by any other reasoner; but concerning the third or the moral argument he considers it to be sufficient of itself to prove the existence of God. Deep seated in our mental constitution there is a sense of moral accountableness, of duty and obligation. No adequate explanation can be given of these phenomena in our mental constitution, excepting by the existence of a just and holy lawgiver, and "this theology of conscience has done more to uphold a sense of God in the world than all the theology of academic demonstration." Concerning this Kant observes, "The belief in a God and in another world is so interwoven with my moral nature, that the former can no more vanish than the latter can ever be torn from me" ("Kritik der reinen Vernunft.," ed. Hartenstein, p. 547). Considered in the light of human history it must be admitted that the belief in God, with its corollaries of awe, trust, and reliance, has formed the most powerful motive which has influenced human conduct in the past, and that it also forms the strongest incentive to duty and firmest foundation for hope in the present.

In conclusion, it must be observed that all human thought of God must, from the nature of things, be partial, inadequate, and imperfect. We can hardly form an adequate conception, *i.e.* a complete and sufficient mental picture, of anything, and the smallest and simplest natural object suggests questions quite unanswerable in the present condition of human knowledge. Hence, though human thought may be sound and justifiable as far as it reaches, yet assuredly a single drop of water compared with the ocean but faintly represents the sum-total of human knowledge as compared with the infinite reality of God.

For a consideration of the Christian conception of God see under TRINITY, and for an account of such systems as deny or seek to dispense with the idea of God see AGNOSTICS, ATHEISM, COMTE, POSITIVISM, and MATERIALISM.

GODS, HEATHEN. See MYTHOLOGY, CLASSICAL; and NORSE MYTHOLOGY.

GOD SAVE THE KING, the title of the British National Anthem. Its authorship was much disputed, many attributing it to Dr. John Bull, musician to James I., who composed an ode in honour of the king; but this ode has been found, and has nothing of "God save the king" but its title. But curiously enough another air of Bull's for the harpsichord would be much like our famous national anthem were it not in the minor key. A minuet of Purcell's also comes very near the tune indeed. Recent inquirers, however, give both words and music to Dr. Henry Carey, who composed them in honour of a birthday of George II., in the year 1740. The fact of Carey's authorship is testified to by J. Christopher Smith, Handel's amanuensis, and by Dr. Harrington. The anthem was printed in the *Gentleman's Magazine* in 1745. The words were somewhat altered on the accession of the two last monarchs. The melody of "God save the King" serves also as the Danish and the German national air.

GOD'ALMING, a market-town and municipal borough of England, in the county of Surrey, 4 miles S.W. of Guildford and 32½ from London by the South-western Railway, is situated on the south bank of the Wey in a sheltered valley. The streets are narrow and irregular. The river is crossed by a bridge of brick. The church, a cruciform structure, exhibits almost every style of architecture, from Norman to Perpendicular, and has a lofty steeple containing eight bells. Several district churches have been built in the neighbourhood. There are also several dissenting chapels and a large public hall. A very fine building in the fourteenth-century Gothic, in place of what was previously the London Charter-house School, was erected in 1872. The buildings are so arranged that in bad weather the boys, at whatever part they reside, can pass to the school, hall, or chapel without going out into the rain. The grounds purchased by the trustees are over 70 acres in extent, and of these eight have been converted into an excellent cricket ground. Godalming is famous for its manufacture of fleecy hosiery; it has also a timber wharf, tanyards, and paper-mills. Its corporation consists of four aldermen, including the mayor, and twelve councillors. Population of the municipal borough in 1881, 2505; of the parish, 8640. Godalming is a town of Saxon origin, and was known in early times as *Godhelm's Ing*, meaning the meadow of Godhelm, a Saxon thane.

GODAV'ARI (Godavery). A great river of Central India, which runs across the Deccan from the Western to the Eastern Ghats; for sanctity, picturesque scenery, and utility, it is surpassed only by the Ganges and the Indus. Its total length is 898 miles; estimated area of drainage basin, 112,200 square miles.

GODAV'ARI, a district of British India, in the Madras Presidency, lying between 16° 15′ and 17° 35′ N. lat., and between 80° 55′ and 82° 38′ E. lon. The area is 7345 square miles, and the population 1,600,000. The district

is divided into two almost square parts by the Godavari River. The deltas of that river present a vast and unbroken expanse of rice cultivation, dotted by villages, and varied only by clusters of palmyra, cocoa-nut or betel-nut palms. North of the delta the land gradually undulates, and the horizon is broken by conical hills. The forest tracts are those of Rampa and Bhadriachalam. The chief jungle products are myrabolans, soap-nuts, tamarinds, bamboo-rice, honey, and beeswax. The wild animals comprise the tiger, leopard, hyæna, wild boar, antelope, deer, wolf, and bear. Game birds are plentiful.

GOD'BOTE (Saxon *God*, and *bote*, a fine), among the Saxons and Normans an ecclesiastical penalty for any crime or offence committed against God or his holy church; and of this the priest was presumed to be the judge. That which was presented as an offering to God, or his service, was named *God-gild*.

GOD'FATHER and **GOD'MOTHER**, the names given in the Roman Catholic and Episcopal churches to the persons who act as sponsors for children at baptism. In most other churches the parents of the child occupy the place of sponsors, the father himself promising to watch over and train the child. In the case of Baptists the rite is delayed until the individual reaches an age at which the vow can be intelligently understood and taken.

In the Roman Catholic Church the position of godfather and godmother is held to constitute a spiritual relationship. Marriage between them and the baptized or parents of the baptized is forbidden. In the Episcopal Church this is not the case. The old English word *godsyb*, now written *gossip*, used to include both sponsors. As in the baptism of a female child two godmothers are required, these *godsybs* used to meet to talk about their spiritual child; hence the word soon became current as *gossip* for gadding and speaking idly about others. Thus Dryden—

> "'Tis sung in every street,
> The common chat of gossips when they meet."

GODFREY DE BOUILLON. See BOUILLON.

GOD'MANCHESTER, a town and municipal borough of England, in the county of and three-quarters of a mile S.E. from Huntingdon, and 60 miles from London by the Great Northern Railway, the nearest station being at Huntingdon. It was for many centuries famed for its very superior husbandry. It has a fine parish church, which was restored a few years since. There are an iron-foundry and machine works, and some small manufactures of malt, oil-cake, and leather. The parish, which forms part of the parliamentary borough of Huntingdon, contains a population of 2188. The municipality is composed of four aldermen, including the mayor, and twelve councillors. The town was formerly known as *Gumcester*, and has probably declined from a position of greater importance as Huntingdon has risen in prosperity.

GODOLPHIN, EARL OF (SYDNEY GODOLPHIN), was a younger brother of a family said to have been settled at Godolphin, in Cornwall, before the Norman Conquest. His father was Francis Godolphin, who was made a knight of the Bath at the coronation of Charles II., 23rd April, 1661. The date of his birth is unknown; but he is said to have been very young when first introduced, in 1645, to Charles II., then Prince of Wales. On the Restoration he was appointed a groom of the bedchamber. In the beginning of 1678 he was employed in the management of a correspondence between the Duke of York (afterwards James II.) and the Prince of Orange (afterwards William III.) on the subject of the union of England and Holland against France. This led to Godolphin's appointment, 26th March, 1679, as one of the lords of the Treasury; and in September following, on the dismissal of the Duke of Monmouth and Lord Salisbury, he was, along with Lord Hyde (afterwards Earl of Rochester) and the Earl of Sunderland, intrusted with the chief management of the national affairs. When Sunderland was dismissed in 1680, Godolphin continued in power. After acting as one of the principal secretaries of state he returned to the Treasury, and was placed at its head, with the title of Baron Godolphin. During the reign of James he is said to have been one of the chief advisors of the king, who, when the Prince of Orange landed, sent Godolphin and two other noblemen to negotiate. On the establishment of the new government Godolphin was continued as a lord of the Treasury, and (with a temporary interregnum) so remained until May, 1697, when he was replaced by Mr. Charles Montagu, afterwards Earl of Halifax. In 1700 Godolphin again entered office, and on the 8th of May, 1702, he became lord high-treasurer. He was now aided by his connection with the Earl (afterwards Duke) of Marlborough, whose daughter and successor in the dukedom afterwards married Godolphin's son and heir. On the 29th of December, 1706, Godolphin was created Viscount Railton and Earl of Godolphin, having been previously, in 1701, made a knight of the Garter. Gradually both Marlborough and Godolphin leaned towards the Whig party, and the latter openly joined it from about 1706. Mrs. Masham and Harley having finally supplanted the Duke and Duchess of Marlborough in the queen's favour, Godolphin was suddenly and rudely dismissed on 8th August, 1710. He died on the fifteenth of September, 1712, leaving one son, Francis, to inherit the title, which became extinct on his death, and though revived for another relative, became again extinct. Godolphin's administration was made especially memorable by the victories of Marlborough and the union with Scotland.

GOD'UNOF, BORIS, Czar of Moscow, was born in 1552, of a noble family of Tartar descent. He was attached to the court of the czar, Ivan Vassilevich the Terrible, at the age of twenty-two, where by his prudence he obtained the favour of the tyrant without aiding him in his cruelties. In 1580 the heir to the throne, Prince Feodor, married Godunof's sister Irina, which so increased his influence that in 1582, on Feodor's accession, the whole power of government was thrown into his hands. The brother and heir of Feodor, Prince Dimitry, perished by assassins at Uglich, where he resided, in 1591; but the people of the place rose and killed the murderers. Godunof (who is believed to have instigated the crime) caused a commission of inquiry to be issued, which declared the case one of suicide, and the presumed murderers innocent. Feodor, weak alike in mind and body, was satisfied, and the most horrible punishments were inflicted upon those who had killed the murderers. They were killed or banished, and their town became a desert. Feodor died in 1598—the last of the Rurik dynasty in the direct line. The czarina, Irina, was proclaimed sovereign, but in a few days she retired to a convent, and declared her unalterable resolution to take the veil. Her brother, Godunof, was then immediately hailed as sovereign by universal acclamation. He, however, refused the throne; and a general assembly of the states met on the 17th of February, 1598, and unanimously proclaimed Godunof czar of Moscow. After some resistance he accepted the crown. He ruled very vigorously. He first quelled the turbulent Khan of the Crimea. Siberia was finally subjugated. Notwithstanding several particular failures in his foreign policy, Godunof succeeded on the whole in establishing his country in an honourable position among nations. He maintained a close connection with England and with Queen Elizabeth. To promote the civilization of his country he sent young men of noble families to England, Germany, and France, and in many other ways strove, and with success, to elevate his country. In 1604 a rumour spread abroad that Prince Dimitry was alive, and preparing in Poland to assert his rights. It is impossible to ascertain now whether or not

this was an imposture. But the so-called prince levied an army, entered Russia, was joined by the forces sent to oppose him, and was in full march upon Moscow when Godunof died suddenly, on the 13th of April, 1605, having, it is suspected, taken poison. His son Feodor reigned for a short time over a portion of the Russian dominions, but was murdered in June of the same year at Moscow. The false Dimitry was acknowledged by his supposed mother, who pretended to recognize him, but she was subsequently forced to own that she had been guilty of deception.

If not noteworthy for the extraordinary rise to power of Godunof, this reign would be made remarkable in Russian annals by the institution of Russian serfdom, whereby the peasants were rendered almost as much parts of the soil which they cultivated as the trees or anything else which grew there, sold with the land or passing from heir to heir—a dreadful blot on Russia only wiped away so lately as in our own time by Alexander II. This was a desperate device of Boris Godunof to endeavour to check the rising of the people in masses against him. They hated him, and to him alone they attributed (in many cases quite wrongly) the murders, famines, and invasions which desolated the land, whether under his own reign or while he ruled as *maire du palais* for the feeble Feodor. Godunof's reign was succeeded by a period of anarchy, lasting till the rise of the Romanoff (the present) dynasty.

GODWIN, WILLIAM, an English author, son of a dissenting minister, was born 3rd March, 1756, at Wisbeach in Cambridgeshire. At first educated at Norwich by a private tutor, he was sent at seventeen to the dissenters' college at Hoxton, and in 1778 entered the ministry, and officiated for five years in the neighbourhood of London, to which he then removed and sought subsistence by authorship. In 1793 appeared his "Political Justice," which excited great attention at a time when the government were constantly prosecuting those who exhibited sympathy with the French Revolution. Godwin, in a passage of remarkable dignity, expressly anticipated the fate that might befall him, while, however, asserting the calm, peaceable, and thoughtful character of his work. He was not prosecuted, but his work subjected him to much obloquy. Next year appeared his novel of "Caleb Williams," which greatly increased his reputation.

Towards the close of 1794 some of Godwin's chief friends, Holcroft, Horne Tooke, Thelwall, Hardy, and others, were arrested and brought to trial on charges of high treason. Godwin, who had refused to join all such revolutionary societies as those of which his friends were members, now by his pen rendered the most valuable aid to them, and, it is thought, contributed greatly to their acquittal.

In 1797 he published the "Inquirer," a collection of essays on moral and literary subjects. In April of the same year he married Mary Wollstonecraft, with whom he had been living for some months. Mary had peculiar ideas on marriage, and had already tried one union without a legal tie, ending with the most disastrous results. Nothing daunted she entered into a second with Godwin, but so much inconvenience was felt by the pair that as a concession to popular prejudice they submitted to the usual marriage ceremony. Among other peculiarities related by Godwin was that of making a point to avoid each other for a great part of the day, for fear of satiety. These curious unconventionalisms do not prevent Mary Godwin from winning our regard as a pure and virtuous woman. She died in childbed in September of the same year, leaving a daughter, who became the wife of Shelley. In 1798 Godwin edited his wife's works, and published a small memoir of her. The novel of "St. Leon" was published in 1799. The following year he visited Ireland, where he resided principally with Curran. In 1801 he married again. His "Life of Chaucer" appeared in 1803, and his third novel, "Fleetwood," in 1804. About this period he became a bookseller, and wrote many school-books under the name of Baldwin. His other works were an "Essay on Sepulchres," in 1808; the novel of "Mandeville," in 1816; the "Treatise on Population," in reply to Malthus, in 1824; the "History of the Commonwealth," 1824 to 1828; "Cloudesley," a novel, in 1830; "Thoughts on Man," in 1831; and lastly, the "Lives of the Necromancers," in 1834, written at the age of seventy-eight. His circumstances for some time before his death were rendered comfortable by a situation in one of the public offices, conferred on him by the Grey ministry. He died on the 7th of April, 1836.

GODWINE, Earl of Wessex, a famous Saxon noble, was born near the end of the tenth century. He married a daughter of King Canute, and helped to restore the line of Saxon monarchs in the person of Edward (the Confessor), Ethelred's son, to whom his own beautiful and accomplished daughter, Edith, was given in marriage. He was, however, banished by his son-in-law on account of his protests against the Norman favourites of Edward, and for the crimes of his son, Earl Swegen. In 1052 he returned, and, backed by the whole people, forced the king to expel the Normans from the country, and to restore his (Godwine's) possessions and honours. The earl died in 1053.

There is no doubt Godwine, ardent patriot though he was, aimed steadily at the crown. His daughter bore no son, as he doubtless hoped she might, to inherit the kingdom of Cerdic, because of Edward's absurd monkish ideas of purity. Godwine, then, got much of the kingdom into his control. His son Swegen had the west-midland earldom (Somerset, Hereford, Gloucester, Berks, Oxford); Harold had East Anglia; his wife's nephew, Beorn, had Northampton and Huntingdon. Godwine himself was Earl of Wessex—that is, all England south of the Thames save Berkshire. But Swegen killed Beorn and did other crimes, and this plan also failed. At Godwine's death his son Harold continued his father's policy. He held the earldom of Wessex and the Welsh border, Hereford, &c.; his brother Tostig (the king's, and especially Queen Edith's favourite) had the earldom of Northumbria; his brother Gyrth ruled his own old earldom of East Anglia, and his brother Leofwine was Earl of Kent and the Home Counties. Men were accustomed in those days to the rule of the Godwine family, which was for the most part a just rule. Harold was elected king with great joy on the death of Edward.

GOD'WIT (Limosa) is a genus of birds belonging to the snipe family (Scolopacidæ). The legs are long, and the bill very long and very slightly curved upwards. The best known species is the Black-tailed Godwit (*Limosa melanura*). This bird has a wide range, extending throughout the northern half of the eastern hemisphere. It extends north as far as Iceland. In England they appear chiefly in the spring and autumn, on the way to and from their northern breeding places. In former days it appears that they bred regularly in Norfolk and the Fen district. These birds were greatly prized for the table. Their food consists of insects and their larvæ, worms, &c. The nest is formed of dry grass and herbage, and the four eggs are light olive brown, blotched and spotted with darker brown. The black-tailed godwit measures from 16 to 17 inches in length. The female is rather larger than the male. Its plumage varies greatly with the seasons. The Bar-tailed Godwit (*Limosa rufa*) also visits England in the spring and autumn. This species agrees with the preceding in its habits; it, however, is slightly smaller and has shorter legs. Several other species of godwits have been described from America and Asia.

GOETHE (or GÖTHE), JOHANN WOLFGANG VON, the master poet of the eighteenth century, who,

coming at a time when Europe, and especially Germany, had long been sterile in real song, attained in the civilized world a place as an architect of human character beside Dante and Shakspeare, and in his own country the position of poet-teacher and national idol. Though Goethe owes this high position in the esteem of the world chiefly to his peculiarly cosmopolitan breadth of sympathy, and to his vivid power of realizing and depicting the struggles, passions, and hopes universal among men, he was a thorough German in thought and character, and it is perhaps only in his own language and in his own country that the full greatness of his many-sided genius can ever be thoroughly appreciated. In Germany his name and his precepts are household words, and during his life, from the time of his youthful fame to his death in 1832, it was upon him that the whole literary life of the Fatherland centred, faithfully following or accompanying all the developments of his progress.

It was while under the influence of the "Sturm und Drang" poetic movement that Goethe became distinguished, when, in spite of the rough and inartistic system of this school, the touch of his genius made it world-famous. From this time his authority increased, until he became the acknowledged chief of the German literary circle, impressing upon it a character of classic beauty and artistic finish, the value of which he had learned to appreciate while studying the treasures of classic art in Italy.

Rarely has a man destined for fame come into the world under more favourable auspices than Goethe. Born in the wealthy, independent town of Frankfurt on the 28th of August, 1749, the position of his father as an imperial councillor in easy circumstances, with some taste for poetry and art, early opened to him the circle in which he might meet the finest minds of Germany, and he thus immediately came under the full influence of the impulse given to German patriotism by the victories and life of Frederick the Great, and by the philosophical and literary efforts of Lessing. Destined by his father for the profession of the law, it is probable that the opposition to his determination to follow literature was sufficient to stimulate and steady him in his chosen course without really causing injurious effects. At the age of sixteen he was sent to the University of Leipzig, before which he had had little regular education, and here, though supposed to be studying for his profession, he spent most of his time in social enjoyments. In 1770 he was transferred to the University of Strasburg, where he became interested in chemistry and anatomy. The most important event of his stay here was his meeting with Herder, who introduced him to a new world in the works of Shakspeare. Under this influence he commenced his "Götz von Berlichingen," which was published in 1773 at Weitzler, whither he had gone to complete his law course. The effect of "Götz" was to make him famous throughout Germany, and the publication of "Die Leiden des jungen Werthers" (the Sorrows of Young Werther) in the following year extended his fame all over Europe.

The petty courts of the numerous German princes were at this time the chief centres of literary activity, and in 1775 Goethe accepted the invitation of the Duke of Saxe-Weimar to reside at his court. Here he filled several public offices of state, and Weimar became his home until the close of his life. A visit to Italy in 1786 proved a turning-point in his career. On his return his character became more self-reliant, and his writings assumed a more classical form. It was at this time that he met Christiana Vulpius, who was his loved companion until her death, sixteen years before that of her husband. During the wars of the French Revolution Goethe saw some military service, and he was in the thick of the fight at Valmy. In 1794 the close friendship was formed with Schiller, which was to have so great an influence on the writings of both. The most memorable year in his after-life, which was spent in wonderful literary activity. was 1808, when he had an interview with Napoleon, and published the first part of "Faust" for the first time in a complete form. His death took place on the 22nd of March, 1832.

Goethe's character, bright and joyous, and untinged with the least touch of the harshness induced by adverse circumstances, was one eminently calculated to attract the love of those with whom he was brought in contact, and sometimes a flirtation may have been pushed too far, as in the case of the sweet Frederika of Sesenheim. It may be, however, that the play of imagination he allowed himself in his prose autobiography, "Dichtung und Wahrheit," renders the view of him contained therein hardly fair. In this work, "Imagination and Reality," or "Poetry and Fact" (the title is somewhat difficult to render accurately), Goethe is to be understood while not misstating anything, yet as here and there throwing the glamour of romance over passages of which he desired to heighten the effect. Certainly to consider Goethe as a Burns or a Byron, or indeed as otherwise than an honourable man in his relationships with women, would be an unpardonable error in these days of fuller knowledge. He chose to defer his marriage with Christiana, very foolishly and improperly, but he was always faithful to her, whether before or after their formal union.

The wonderful scope of the writings of Goethe is unique in the history of literature. Though his lyrics are of surpassing beauty, it is in his dramas that he attains his highest excellence and inculcates his noblest teaching. His ballads are beautiful, as witness the "Erl King." His scientific writings, while they show an originality of inquiry that sometimes carried him far in advance of his times, are, as might be expected, of much inferior interest to his poems. Here it will be impossible to do more than glance at the principal and more characteristic of his works, which have been roughly classed, according to the management of their themes, as *sentimental*, *ideal*, or *didactic*.

The chief works of the first class are the "Götz" and the "Werther." The first of these, notwithstanding the rudeness of its style, the absence of artistic form, and the want of harmonious arrangement between the scenes, had a great effect, as being the first manly appeal to the re-awakening spirit of German chivalry, and as presenting the men and scenes of the sixteenth century with a life-like truth that had long been strange to German literature. The "Werther" was as melodious as the "Götz" had been rugged, and in it Goethe disclosed a musical power of expression the presence of which in the German language had hitherto been undreamt of. In the sentimental sweetness of its tone it appealed irresistibly to the somewhat sickly poetic temperament of the age.

Belonging to the *ideal* class are the first-fruits of the Italian journey, "Iphigenia" and "Tasso," as they appear in their final form. They are both poems distinguished for their classic purity and strength of style. To these must be added the drama of "Egmont," containing much that is beautiful, but wanting in fidelity to history; "Hermann und Dorothea," an idyl coloured with the experience gained in the French campaigns; and the masterpieces "Wilhelm Meisters Lehrjahre" ("Wilhelm Meister's Apprenticeship," excellently translated by Carlyle) and the first part of "Faust." "Wilhelm Meister" is a work that has given rise to endless criticism. Its execution is unequal, but its style is smooth and flowing, and there is an extraordinary charm about some of the characters. It contains some of Goethe's best teaching. The episodes wherein Mignon figures, with her unsurpassable songs and her wild grace, and the fine criticism of "Hamlet," involving a consideration of the dramatic art and of acting, are or ought to be known to all educated persons. Mignon has inspired practically every musician of eminence since her birth, from Beethoven down to Thomas. The last has an excellent

entire opera on the subject. It was in "Faust," however, that the poet's genius was displayed in its most cultured perfection. Here a popular legend, long a favourite street drama, became the vehicle for depicting in the most beautiful form and in the loftiest language the struggle universally waging in the soul of man between his highest moral aspirations and the most powerful longings of his sensuous nature—the severity of the conception being softened and humanized by the touching representation of Gretchen in her innocence and joy and in her terrible sorrows. It is not too much to say that in this poem of "Faust" Goethe changed the conception of the spirit of evil. The old malicious trickster with horns and a tail at once gave way to the figure, which all felt true, of the mocking Mephistopheles, the "spirit which denies." This is at all events the Satan of the nineteenth century, the embodiment of a hell where is no truth, no love, no good, no hope, no belief, no trust, but where great intellectual power and enormous gifts of control over the forces of nature exist, and are always used to lower, never to elevate, the soul of man. Such a wonderful answer to the cry of the thoughtful world as the creation of Mephistopheles has rarely been given in the history of literature.

In the third and last class those works are included that were chiefly written during the later years of Goethe's life, such as the "West-östliche Divan," a collection of poems with a colouring of Eastern expression; the "Wilhelm Meisters Wanderjahre," a work containing some beautiful passages, but yet on the whole tedious to most readers; and the second part of "Faust," written to represent the regeneration of the hero, and abounding in deep teaching and allegorical beauties. This work marked the conclusion of Goethe's long literary labours.

Few great men in any department of intellectual achievement have had the good fortune to find a biographer at once so appreciative and so discriminating as the great German poet-philosopher found in the late G. H. Lewes. Another life of him in English by W. Hayward was published in 1878; but the most recent, and in many respects the best life of Goethe yet published is that by Heinrich Düntzer, of which an English translation, with valuable notes and additions, by Thomas W. Lyster, was issued in 1883. Professor Blackie's "Wisdom of Goethe" (London, 1883) has also done much to place the poet before English readers as a teacher.

GOETH'ITE or **GOTH'ITE** is a crystallized hydrous peroxide of iron ($Fe_2O_3H_2O$), of a brownish-yellow or yellow-ochre colour, and containing about 60 per cent. of iron, with a specific gravity of about 4 and a hardness of about 5. It is a valuable ore of iron when in sufficient quantity, and generally occurs with hæmatite and limonite; from the latter it differs in containing a less percentage of water. This mineral has been named after the German poet and mineralogist, Goethe. One peculiarity of this mineral is its showing a blood-red colour by transmitted light when in sufficiently thin sections.

GOG and **MAGOG.** In Ezekiel xxxviii. 2–18, and xxxix. 1–11, Gog is named as king of the land of Magog and prince of Meseeh and Tubal. In Revelation xx. it is referred to as a remote region and people. It has been supposed that the people thus named were the numerous tribes which inhabited the region between the Black Sea and Caspian Sea. The Scripture use of the names clearly indicates that they were a people opposed to the truth of God, and enemies of those who held it. The names are, however, most familiar to Englishmen as those of the two giants in the Guildhall, London. To them a fabulous history is given, which carries their date back more than 3000 years, when Britain is held to have been inhabited by a race of giants, sprung from the marriage of certain wicked women with demons! The old images of Gog and Magog were of wicker-work, and used to be exhibited at lord mayors' shows. They were, however, destroyed by fire, and the present ones, 14 feet high, were put in their place.

GOITRE. See Bronchocele.

GOLCON'DA, a fortress and ruined city, situated in the Nizam's Dominions, 7 miles west of Hyderabad, British India. In former times Golconda was a large and powerful kingdom of the Deccan, which arose on the downfall of the Bahmani dynasty, but was subdued by Aurungzebe in 1687, and annexed to the dominions of the Delhi Empire. The fortress of Golconda, situated on a rocky ridge of granite, is extensive, and contains many inclosures. It is strong and in good repair, but is commanded by the summits of the enormous and massive mausoleu of the ancient kings, about 600 yards distant. These buildings, which are now the chief characteristic of the place, form a vast group, situated in an arid, rocky desert. They have suffered considerably from the ravages of time, but more from the hand of man, and nothing but the great solidity of their walls has preserved them from utter ruin. These tombs were erected at a great expense, some of them being said to have cost as much as £150,000. Golconda fort is now used as the Nizam's treasury, and also as the state prison. The diamonds of Golconda have obtained great celebrity throughout the world; but they were merely cut and polished here, being generally found at Partial, near the south-eastern frontier of the Nizam's territory.

GOLD is a metal which has been known from the remotest antiquity, and has been universally employed as a medium of exchange. Although the quantity of gold which is found, when compared with that of other metals, is small, yet it occurs in greater or less abundance in almost every part of the globe. It occurs in the native state, and combined with silver, and frequently mixed with metallic sulphides and arsenides. A large proportion of gold is the produce of South America; the richest mines in Europe are those of Hungary, Spain, and Piedmont; but it has been found also in the sands of the Rhone, the Rhine, and the Danube; and small quantities are occasionally found in the stream tin-works of Cornwall, in Wicklow in Ireland, in the Lead Hills of Scotland, and in North Wales. The ancient gold mines of Thrace, which yielded the value of £200,000 yearly to Philip of Macedon, and enabled him to sap the foundations of Greek independence with a golden solvent, were in the country of the Bessi, in the Rhodope Mountains, which moderns call by the Turkish name of Despoto Dagh. The Emperors of Constantinople worked them by slave labour for centuries. Gold formerly reached us from the west coast of Africa in such large proportion as to give us the name of the guinea for what once was our chief English gold coin (from the country of Guinea), and to impart in return the name of the Gold Coast. Guineas exist now only on paper, and the Gold Coast long ceased to export gold; but the great gold axe and other ornaments of the King of Ashantee were made well known to us by the Ashantee War, and the old reputation of Africa may yet be restored (see Gold Coast). Gold is also met with in rather large quantities in the Uralian Mountains of Siberia, and in India, but by far the largest supplies of this metal are now obtained from California and Australia. The rich gold region of California was discovered in 1847, in Suter's mill-race, Sacramento Valley, and for several years the yield was upwards of £13,000,000 per annum. It has lately considerably diminished, for while diggers in 1852 could earn ten dollars a day, they can now scarcely obtain a fifth of that amount. In 1839 Count Strezelecki discovered traces of gold in Australia, but the governor of New South Wales persuaded him to keep the matter secret. In 1841 the Rev. W. Clarke, a native geologist, wrote to a friend in the colony that he had found gold ore; but this fact was also

kept from the public in the colony, and was totally unknown in Europe. In 1849 Mr. Smith, who was engaged in some iron-works at Berrima, in Sydney, was induced to search for gold by observations of Sir R. Murchison to the Geographical Society in 1844, in which he stated that he felt certain gold would be found in the vicinity of the Blue Mountains in consequence of their similarity to the Ural Mountains in Eastern Siberia. Mr. Smith's search was successful, but he refused to disclose the place of deposit unless paid £500, which terms the governor refused to accede to. In the meantime Mr. Hargraves, a gentleman who had been in California and gained much experience on the subject, went to Australia and soon made a discovery of gold on the banks of Summer Hill Creek and Lewis Ponds rivers, small streams running into the Macquarie near Bathurst. This discovery was no sooner made than several other places in Bathurst and the adjoining counties were found to contain rich deposits. In August of the same year (1851) further discoveries of gold were made at Ballarat in Victoria, which excelled in richness those of the Sydney district, and these in turn were soon surpassed by fresh discoveries in the Mount Alexander range.

Very careful estimates lead to the conclusion that in the 350 years from 1500 to 1849 the production of all the gold mines amounted to £560,000,000. In the less than thirty years which elapsed from 1849 to 1876 a quantity of gold was produced equal to the total output of the previous 350 years!

Gold is generally found in small grains or scales, called *gold dust*, but occasionally large pieces or nuggets are met with. The annexed drawing is a much-reduced delineation

of a lump of almost pure gold, weighing 27 lbs. 6 oz. 15 dwts., which was found in the diggings at Forest Creek, Mount Alexander. It measured 11 inches in length by 5 in breadth at the widest part; but much larger pieces have been obtained. Gold is now abstracted from the ore by the processes of crushing, stamping, grinding, and washing. The crushing mill consists of two large cast-iron cylinders or rollers, revolving in opposite directions, which break the ore into small pieces as it passes through them. It is then stamped, *i.e.* crushed still smaller, by means of a stamping mill; and to pulverize it still further, it is passed through a grinding mill. It is then washed by a variety of sieve-like machines, and most of the pure metal thus separated from the quartz and other rock particles. But after the most careful treatment small particles, invisible to the naked eye, remain, and to obtain these an amalgam is made by mixing it with mercury, which seizes and dissolves the gold particles, however minute.

The extraction of gold from quartz is a large industry. By careful working a five-millionth part of gold can be profitably extracted. A large proportion, however, escapes the action of the mercury by this wet process, and is carried away in the washings. An improved method has been recently proposed, which consists in crushing the quartz and grinding it dry to an impalpable powder, and then forcing it through the mercury; this method is said to extract the whole of the gold from the ore, and even to make old worked ores pay for reworking. Sodium amalgam has also been used for increasing the solvent action of the mercury. The gold is obtained by distilling off the mercury, the pure metal is left behind, and the mercury used again.

Gold is a beautiful metal of a yellow colour, and capable of a fine polish; the atomic weight is 196, the symbol Au. When quite pure it is as soft as lead, and is the most malleable and ductile metal known. A grain of gold has been drawn out into 500 feet of wire, and it has been beaten into leaves having a thickness of only one two-hundred-thousandth part of an inch. At this thickness it is quite translucent, transmitting light of a green colour, which becomes red when it is heated. The specific gravity is 19·3. The melting-point is 1200° C. (2192° Fahr.), and it is volatile at higher temperatures. It forms a white amalgam with mercury, which is fluid. A solid amalgam is found native in yellow crystals in California.

The amalgam of gold has been long used for gilding, but it is now superseded by electro-gilding, the gold being deposited from solution in cyanide of potassium. Gold is insoluble in hydrochloric and nitric acids separately, but mixed together these acids dissolve it by the development of chlorine. This element, and also bromine and iodine, attack it strongly, forming the chloride, bromide, and iodide. There are two chlorides, the protochloride or aurous chloride ($AuCl$), and the trichloride or auric chloride ($AuCl_3$). The former is insoluble in water, and the latter is a red soluble crystalline salt used in toning positives on paper in photographic printing. There are two oxides, aurous oxide (Au_2O), a green insoluble powder, and auric oxide (Au_2O_3), a black powder, known also as auric acid. With the alkalies it forms salts called aurates. Of these the most remarkable is the aurate of ammonium, $Au(NH_4)O_2NH_3$, a dangerous salt known as fulminating gold. It is very explosive; the temperature of boiling water or a blow with a hammer will explode it.

Gold is easily detected and separated from other metals on account of the ease with which it can be thrown down from solution in the metallic state by reducing agents, such as sulphate of iron or oxalic acid. Chloride of gold, when treated with chloride of tin, forms a beautiful purple precipitate known as purple of cassius. This is a very sensitive reaction, by which one part can be easily detected in 64,000.

Most metals are susceptible of combining with gold to form *alloys*, of which the most important is that with copper, which, from its greater hardness, is used for coins and jewelry. Silver is also used for giving it a lighter colour. The weight of gold is estimated in carats, 24 of which go to the ounce. Articles described as of 18, 20, or 22-carat gold are thus so many twenty-fourth parts pure gold, the remainder being made up of various alloys. British standard gold is an alloy of 11 parts pure gold and 1 part pure copper, known as 22-carat fine.

Gold as Currency. The greatest value of gold is one conferred upon it by the general agreement of civilized nations to accept it as their chief or standard medium of Exchange. In this way the value which belongs to every kind of labour is represented in a durable and convenient form. The hardness and strength of gold, when suitably alloyed, its chemical stability in the atmosphere, its divisibility without loss of substance, its distinctive weight and colour, its comparative scarcity, and the regularity of the cost of its production—all combine to render it specially fitted for this purpose. Gold, then, representing the price or value at which every kind of labour can be obtained, becomes the chief universal object of desire, and as in its use in the arts and sciences, so, like any other article of commerce, as money it fluctuates in value according to the ordinary laws of supply and demand. It should be here observed that the value of gold as a

circulating medium entirely depends on the quantity of metal, and not on any convenient marks placed upon it by governments. It results from this that whenever there is an increase in the quantity of gold available for currency purposes, it is indicated by a fall in prices, and a decrease brings a contrary result. In other words, prices are an index of the purchasing power or *exchangeable* value of gold, and it is most important, in drawing conclusions as to the state of trade from the prices quoted in trade reports, to distinguish between effects produced by fluctuations in the cost or quantity of the metal itself produced and put into circulation and those produced by real alterations in the condition of commerce. In the first case trade may in no wise have altered, and yet prices may show a considerable rise or fall. At the same time every alteration in the condition of commerce has a tendency to produce an analogous effect. Thus with increased activity of trade more gold is needed to facilitate exchanges, and should the activity be universal gold is everywhere in greater demand, men will give more of their labour for it, and prices as stated in gold currency will fall; but if, as is generally the case, the activity is local, money, otherwise gold, becomes *dear* at that spot and gold is attracted from places where there is less demand for it, until an equilibrium is produced. The condition of the demand for gold at the centre of activity is indicated by fluctuations in the rate of discount for bills, which rises with the scarcity of the metal and falls with its abundance.

The cheapening of the cost of the production of goods by machinery, improved means of transport, and many other causes also affect the purchasing power of gold.

The quantity of gold at any one time in circulation is very small compared with the value of the transactions it facilitates, and it is the aim in modern times to reduce the need for it as much as possible by banking, bills of exchange, and systems of credit; but since paper only represents local credit, and gold represents a universal standard of value, it is clear that there should always be a sufficient quantity of gold within reach to meet the balances of exchanges between various places, and for the daily popular requirements.

The effect on prices caused by a large increase in the area over which gold is employed as a chief medium of exchange, —resulting in the absorption of upwards of £150,000,000 by Germany, Italy, and the United States for currency purposes in one or two years, beginning with 1880—combined with an annual decrease in the supply, gave rise to much discussion, in the course of which several interesting facts bearing on the subject of gold were elicited. Mr. Goschen, who commenced the discussion with a paper delivered at the London Institution, states in a letter dated the 4th of May, 1883, that the "annual production of gold during the first five years after the discoveries of 1851 averaged nearly £30,000,000. It now amounts to less than £20,000,000." Of this sum as much as half is said to be taken up by the arts and sciences, leaving the small sum of £10,000,000 to cover the new coinage demands and the loss by wear in circulation. That the latter is something considerable throughout the world may be judged from the fact that for England alone in 1884 the mint authorities estimated the expense of recoining 100,000,000 sovereigns at £750,000. The annual wear of a sovereign has been closely estimated at ·0425 grain, and that of a half sovereign at ·04379 grain. The experience of bankers leads them to the conclusion that in the weighing of "light" gold, that is, gold which has been in circulation, on an average 100 sovereigns require a half sovereign as a make-weight to turn the scale, while the estimate as to the deficiency on 100 half sovereigns is more variable, extending from 7*s.* 6*d.* to 25*s.* per cent.

In England gold is the only legal tender for sums over 40*s.*, but in many countries silver can be tendered for any amount. In England, and in many countries, the gold coinage is the only true coinage in the sense of representing its nominal value, the silver, and still more the copper or bronze coins, being really "tokens" rather than coins, and not representing in metal the amount for which they pass.

GOLD COAST, a British colony in Western Africa, Upper Guinea, extending about 220 miles from west to east, between the rivers Ankobar and Volta, and divided, till within recent years, between Great Britain, Holland, and Denmark. It constitutes one of the divisions of Western Africa respectively known as the Grain, Ivory, Gold, and Slave Coasts—named after the special character of the production and trade of the districts. The population of the Gold Coast under the dominion of England is estimated at 400,000. The annual revenue and expenditure average £100,000.

The whole coast, being only 5° N. lat., is considered one of the hottest countries on the globe, and its climate is in general very unhealthy to Europeans. At no great distance from the coast, however, the interior rises rapidly, and offers a climate which, if thoroughly tropical, is at all events pleasant and salubrious compared with that of the coast. Travellers who have penetrated it speak with admiration of its beautiful scenery, its vast forests, its emerald meadows, and sparkling rivulets. There were formerly few roads, the communications between the different villages consisting of mere tracks passable but in single file. This, however, is fast being remedied under the present administration. Beasts of burden are not known, and merchandise of every description is carried on the heads of natives. The great rainy season lasts from March till June, but a short rainy season occurs in October and November. September is the hottest month.

The whole coast-line presents materials for trade, the principal article produced and exported being palm-oil. Extensive plantations have been formed for the cultivation of the palm, and manufactories for the oil. The other exports consist of ivory, gum, skins, maize, and ground-nuts.

Guinea has from time immemorial supplied the world with considerable quantities of gold; but it is only within the last few years, and since some of the richest auriferous grounds of Australia and California have shown signs of exhaustion, that European enterprise has once more turned to the neglected diggings of Western Africa. The closer knowledge of the country acquired since the last Ashantee War has revealed the fact that the soil of the whole of the British protectorate is impregnated with gold, and that it may be also expected to supply copper, zinc, iron, and precious stones. It speaks well for the prospects of mining enterprise that "hydraulicking" can be carried on in most localities under advantageous circumstances, and that while in Australia water has to be carried long distances through pipes or leats, at the Gold Coast it abounds everywhere, and may be had for nothing. So plentiful indeed does both gold and water seem in some places, that Mr. Thompson, when lately reporting upon his journey of 123 miles from Accra to Prahsue, *via* Insabang and Insuaim, returning to Elmina by Acroful, Abracampah, and Assayboo, mentions that after crossing the Aynsue, which was then, in the dry season, 25 feet wide and 2½ feet deep, being 20 feet deep and 60 feet wide when full, he found that at the neighbouring village of Asafu gold is collected in the street gutters after rains, and that he saw about four grains found on the previous day. The Acora is another fine stream, 20 feet wide and 3 feet deep, and at Aguna Swaydra, on its right bank, fine specimens of auriferous quartz from Quabin were seen.

The Portuguese appear to have been the first who established themselves on the Gold Coast for trading purposes. Elmina, the principal settlement, was founded by them; but Captain Kuhn having by a daring feat of arms

established himself here, the stronghold was formally ceded to the United Netherlands. In 1672 the Royal African Company of England, in the endeavour to establish rival settlements, involved the Dutch in never-ending quarrels, in which the latter were finally worsted, and had to submit to the erection of English rival forts and factories in close proximity to their own. The rivalry continued, and was entered into by the natives, who took the side of either for the time as interest or inclination dictated. Native feuds and petty wars continually arose, the Ashantees and Fantees alternately claiming jurisdiction over the coast occupied by the Dutch and English trading companies. Numerous contests with the Ashantees took place, resulting in some instances disastrously for the English, especially in 1824, when after an encounter at Esmacow, the governor of Cape Coast Castle, Sir Charles M'Carthy, and a number of English officers were killed and their heads taken in triumph to Coomassie. Ultimately the Ashantees were routed at the battle of Dodowah, on the 26th August, 1826, and driven out of the country. The charter of the African Company was withdrawn in 1821, and the English seriously entertained the idea of withdrawing from the country; but an arrangement was made with the merchants on the coast by which the government made a grant to aid them in maintaining the forts. In 1844 the government resumed the direct control of the Gold Coast settlements, and by the system then adopted the native chiefs and kings retained a considerable amount of power and influence.

In the course of time, however, the protected tribes became more and more dependent on the English, and when the Ashantees crossed the Prah in 1873 they were quite unable to defend themselves. The invaders pushed on to within a short distance of Elmina and Cape Coast Castle. For a time the position of the English settlement was extremely critical, but Sir Garnet (afterwards Lord) Wolseley was despatched with a force from England, and early in 1874 the Ashantees were driven back, their capital burned, and King Koffee forced to conclude a treaty binding him to pay an indemnity, &c.

The division of the coast between the British, Dutch, and Danish governments had been long fertile in misunderstandings and difficulties, and with a view to ending the embarrassments of the situation the British government expressed its willingness to acquire by negotiation and purchase both the Danish and Dutch settlements, so as to consolidate the whole into one compact territory. The possessions of Denmark were acquired at various periods from 1852 to 1868, and those of Holland in 1872. Neither country showed much reluctance to part with its African settlements, they having long been not only troublesome and costly to maintain, but comparatively worthless for trading purposes. By far the largest territory transferred was that of the Dutch, and the terms were the valuation price (£3750) of the stores and furniture in the forts, and liberty to the Dutch to make, unmolested, certain annexations in Sumatra.

The territory transferred by the Netherlands government to the British crown in 1873 extends about 90 miles west of Elmina, the strongest post on the coast, and includes a number of minor towns and villages. The Dutch divided their territory into seven districts, named after the chief places in each, Appolonia, Axim, Dix Cove, Bantri (Boutry), Sekondi, Chama, and Elmina. Elmina was the capital of the Dutch possessions.

Parliament having resolved, after the war of 1874, to retain the Gold Coast settlements, a new administration was established, now known as the Consolidated Settlement of the Gold Coast and Lagos. The seat of the government was removed from the unhealthy neighbourhood of Cape Coast Castle to Accra, and a sanitarium established. The French still retain some few forts and trading ports along the Gold Coast, while on the other hand there are English stations on the Gambia, where French power predominates. It was proposed to Parliament in 1876 to exchange these minor possessions, but the opposition to the scheme was so great that the government withdrew it. An interesting work on this protectorate is "To the Gold Coast for Gold," by Captains Burton and Cameron (London, 1882).

GOLD-BEATERS' SKIN, the material used in attenuating gold. It is made from the peritoneal membrane of the large intestine of the ox. The manufacture is an extremely offensive and unhealthy one, and chlorine is used during the process both as a disinfectant and to assist in the separation of the membrane. It is carried on both in England and France. The intestine is subjected to partial putrefaction in order to separate the membranes; then cleansed by soaking, washing, and scraping; dried, stretched, beaten, pressed, and moistened successively with solutions of alum, isinglass, and white of egg; the object being to obtain the pure continuous membrane free from grease and impurities without allowing the putrefactive processes to weaken it. A packet, or *mould*, consisting of 900 pieces of skin, each 4 inches square, is worth £8 or £10. They may be used for gold-beating purposes for many months without becoming thinner or weaker. The skin is also used as a plaster for dressing slight wounds.

GOLD-BEATING. This is a process whereby gold is brought to the state of very fine leaves for use in various kinds of gilding. The remarkable ductility of gold—a quality possessed by it to a greater degree than by any other known substance—is here taken advantage of to the fullest extent as a means of limiting the quantity of this costly material required on a given surface.

It is by a combined process of rolling and hammering that the attenuation of the gold is produced. An ingot of gold is milled or rolled to a thickness of about $\frac{1}{800}$ of an inch, and this ribbon is then hammered. The hammering does not take place on the gold itself, but thin membranes are interposed between the hammer and the gold. These membranes are of three kinds—an outside covering of common parchment, a set of leaves made of very fine and smooth calf-skin vellum, and a set made of the gold-beaters' skin described in the last article. The ribbon of gold is cut up into small pieces, each measuring exactly an inch square, and 150 of these are beaten or hammered at once, interleaved between the membranes, until they are expanded to nearly 4 inches square. They are then removed, cut into quarters, replaced between new membranes of gold-beaters' skin, and beaten again; they again expand to nearly 4 inches square, and are again removed, cut into quarters, and replaced between the skins. A third beating expands them nearly as much as before. The thickness of the film of gold by this time varies from $\frac{1}{180000}$ to $\frac{1}{200000}$ of an inch, according to the purpose for which it is intended. The attenuation may be rendered more intelligible by stating that 100 square feet of the leaf gold weigh no more than an ounce.

A certain greasiness which comes upon the interleaved membranes is removed by beating them between pieces of white paper. The beating of the gold is effected by hammers, weighing from 10 to 16 lbs., on a smooth block of marble; 150 small squares of gold form the group or bundle for the first beating, 600 for the second, and 800 for the third. Machines of very ingenious construction have from time to time been invented for gold-beating, but their use is very limited, and nearly all the gold-leaf manufactured is still beaten by hand.

Two other metals, silver and copper, have sufficient malleability to be brought into the state of thin leaves by hammering, and both are used to a limited extent in this state in the arts.

GOLD-LACE, a fabric formed by weaving silk threads that have been previously gilded. The peculiarity of this

manufacture consists in the gilding of the silk in such a manner that it shall retain sufficient flexibility for weaving. Yellow silk is used for the purpose. The lace when made has all the appearance of burnished gold. But so small a quantity of the precious metal is introduced, that perhaps the thinnest gold wire ever manufactured (the thirty-thousandth part of an inch in thickness) does not approach in thinness the film of gold on the surface of the silver and gold lace. It has been calculated that the gold on the finest silver wire for this lace is not more than one-third of one-millionth of an inch in thickness, or about one-tenth the thickness of ordinary leaf-gold. One process by which this rich-looking material is produced is as follows:—"The silk threads for making this material are wound round with gold wire so thickly as to conceal the silk; and the making of this gold wire is one of the most singular mechanical operations imaginable. In the first place the refiner prepares a solid rod of silver about an inch in thickness; he heats this rod, applies upon the surface a coating of gold-leaf, burnishes this down, and so on until the gold is about one-hundredth part the thickness of the silver. Then the rod is subjected to a train of processes which brings it down to a state of fine wire; it is passed through holes in a steel plate, lessening step by step in diameter. The gold never deserts the silver, but adheres closely to it, and shares all its diminutions. It was one-hundredth part the thickness of the silver at the beginning, and it maintains the same ratio to the end." Numerous other methods of fibre-gilding are practised by passing through chemical solutions and by mechanical forces, but that described above is the original and most universal one.

GOLD'CREST is the name of a beautiful little bird of the family Sylviidæ, or warblers. It is also known as the Gold-crowned Kinglet (*Regulus auricapillus*) and Golden-crested Wren. It is abundant in all parts of Britain, and is to be distinguished from another very rare species, the Fire-crowned Kinglet (*Regulus ignicapillus*), noted for its two black bands on each side of the head. In the former the top of the head of the female is dull pale orange, in the latter bright yellow. The gold-crest is a permanent resident in this country, and indeed receives a considerable accession to its numbers during the winter by a migration from the more northern parts of Europe. It usually inhabits fir woods, where it may be seen exploring the twigs and branches in search of insects, hopping and creeping about with great vivacity, and associating freely, not only with its own species, but also with the titmice and creepers, which resemble it somewhat in mode of life. Its nest is cup-shaped, composed of moss and lined with feathers; it is suspended from three or four twigs beneath the branch of a fir-tree so as to be sheltered from above. The eggs vary in number from six to ten; and the female, while engaged in hatching and bringing up her young, is very bold, allowing the nest to be looked into, and even submitting to be handled without shrinking from her duties. The male has a soft and agreeable song. The gold-crest is the most diminutive of British birds, being scarcely 3½ inches in length. The plumage is yellowish-olive above and yellowish-gray beneath.

GOLDEN AGE is the mythological period of universal happiness before war and suffering, following in the train of civilization, had defaced the lives of men. Then the earth was said to have yielded her produce without labour, and the passions of vice were unknown. The theme was a favourite one with the old Latin poets.

GOLDEN BEETLE. See CHRYSOMELIDÆ.

GOLDEN BULL (Lat. *aurea bulla*), was the celebrated imperial edict whereby the Emperor Charles IV. in 1356 settled the form of election to the Holy Roman Empire (the mediæval empire of Germany), the number of princely electors, &c. The term *bull* is more often applied to papal than to imperial edicts. The *bulla* was a leaden ball or roundish stamped body attached to the edict by way of seal, and in this important bull the seal was, for greater dignity, made of gold. [See BULL, PAPAL.] The electors were fixed by the Golden Bull at seven, the conveuer of them being the Archbishop of Mainz, and the ***primus inter pares*** or president the King of Bohemia. Besides these two there were two other spiritual electors, the Archbishops of Treves and Cologne, and three other secular, the Duke of Saxony, the Margrave of Brandenburg, and the Palsgrave of the Rhine (palatinate). All elections were to go by a majority, and the elections were to be held at Frankfurt, and the coronations at Aix-la-Chapelle.

The Golden Bull is constantly referred to in German history, and although it was altered in certain points, as, for instance, the number of electors, &c. [see GERMANY, HISTORY OF], yet it remained to the last the fundamental law of the empire.

When Frederick-William of Prussia had forbidden his son (afterwards Frederick the Great) to learn Latin—as being unpractical—this Golden Bull (*aurea bulla*), being in Latin, was used as a pretext by young Fritz and his preceptors whereby, under cover of political studies, linguistic studies could be surreptitiously carried on. How the old king saw at once through the device is the subject of one of the raciest anecdotes in Carlyle's masterpiece ("Frederick the Great"). "'*Ihro Majestät*, I am explaining the *aurea bulla* (Golden Bull) to the prince,' exclaimed the trembling pedagogue. 'Dog, I will Golden Bull you!' said his Majesty, flourishing his rattan, '*Ich will dich, Schurke, be-auream-bullam!*' which sent the terrified wretch off at the top of his speed, and ended the Latin for that time."

GOLDEN-EYE (*Clangula glaucion*) is a species of the duck family (Anatidæ), belonging to the subfamily FULIGULINÆ or sea-ducks. The generic characters of Clangula are:—Bill narrow, elevated at the base, somewhat attenuated at the anterior extremity, and short; nostrils inclining to oval, submesial, or rather anterior to the middle of the bill; tail rather long, of sixteen feathers generally.

Though many of this genus frequent the sea, the species are more generally met with in the fresh waters than the other sea-ducks. The species of this genus are found in the northern regions of both hemispheres. The male golden-eye has the irides bright yellow, the head and upper neck green, the lower neck white, a large ovate white spot between the cheek and the bill, the back, rump, and lesser wing-covers black, and the greater wing-covers white. It does not breed in Britain, but as the breeding season approaches it betakes itself to the Arctic regions. Returning in autumn, it is to be met with in most parts of Britain. In Ireland, also, it is a regular winter visitant. It is chiefly to lakes, pools, and rivers that the golden-eyes, or garrots, resort in small flocks. Their food consists of the larvæ of fresh-water insects, fresh-water mollusca, and sometimes of small fishes. The flesh is dark-coloured and unsavoury. The golden-eye usually makes its nest in the holes of trees. The Buffet-headed Duck (*Clangula albeola*) is common in North America, where it is called Spirit Duck, from its rapidity in diving. The Harlequin Duck (*Clangula histrionica*) belongs to the same genus. It is rarely found in Britain.

GOLDEN-EYE FLY (*Chrysopa vulgaris*) is the name of one of the LACEWINGS (Hemerobiidæ), a family of neuropterous insects. It is so called from the brilliant golden lustre of its eyes. This beautiful insect is common in Britain.

GOLDEN FLEECE, a fruitful subject of myths among the Greeks. The most celebrated is that which formed the object of the expeditions of Jason and the Argonauts across the sea.

The fleece was that of a ram, given by Hermes to the

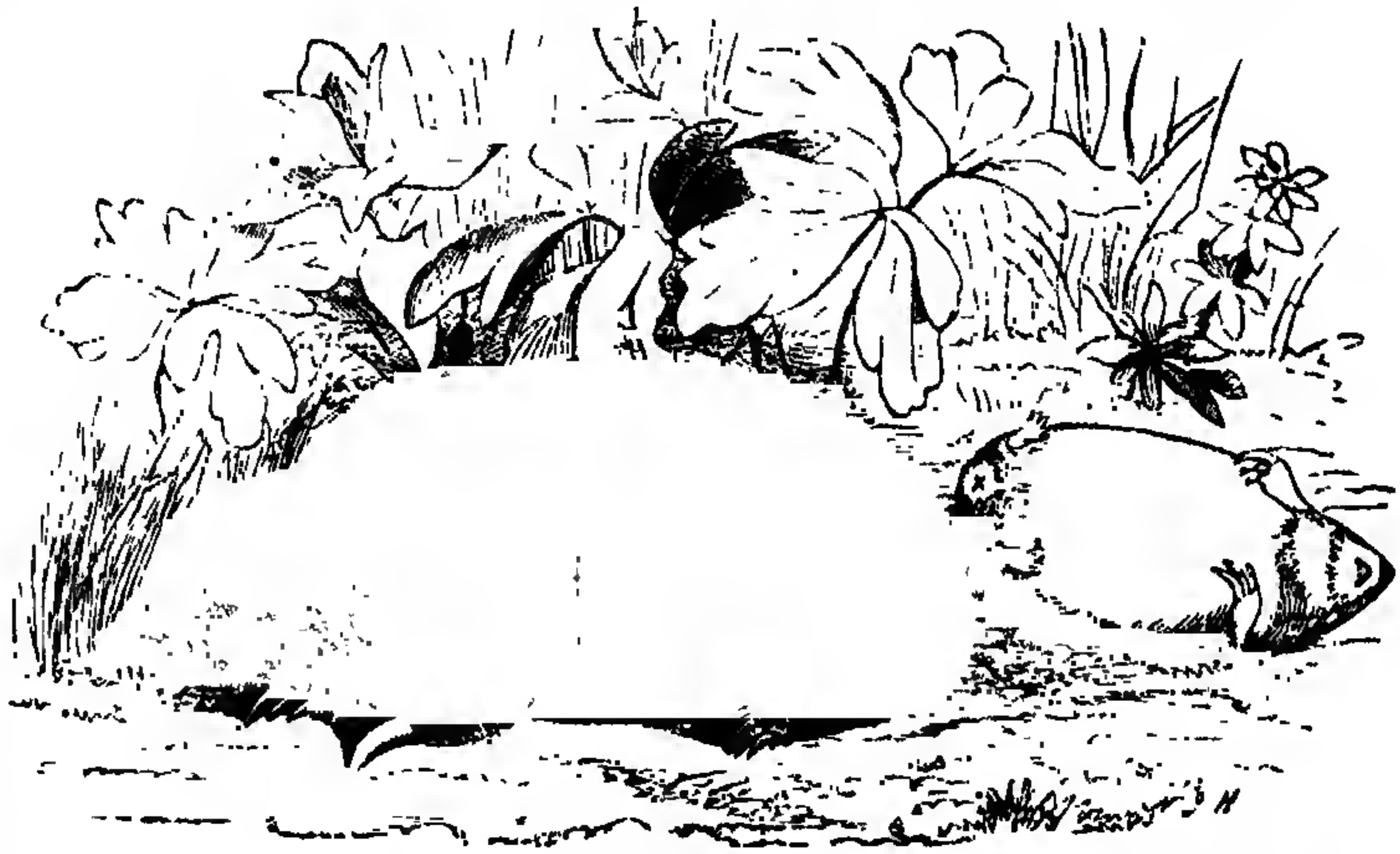
persecuted Phrixos, his votary. This ram had a fleece of pure gold, and was quite as extraordinary for its powers of flight as for its fleece. Upon its back Phrixos and his sister Helle would have both been carried safely through the air across the straits dividing Europe from Asia had not Helle fallen off in mid stream. It is from this fatal occurrence that the Hellespont (Helle's sea) derives its name. The flight of Phrixos and his sister was caused by the decree for their death issued by their father Athamas, king of Orchomenus in Bœotia, who had been deceived by his second wife, Ino, into believing that these children were the cause of a famine that desolated the land, and that their sacrifice to the angry deities would alone suffice to stay the plague. Phrixos and Helle were children of Athamas' first wife, the goddess Nephelê (the mist), whom he somewhat basely deserted for the mortal charms of Ino, daughter of Cadmus. When Phrixos fled his mother induced Hermes to help him with the golden flying ram. On his alighting, sorrowful and alone, on the shores of Asia Phrixos sacrificed the ram to Zeus, and taking with him the splendid fleece coasted the Euxine to Colchis. Here he presented the fleece to Æetes, the king, in gratitude for a kindly reception, and it was hung on an oak in the sacred grove of Ares, where it was guarded by an ever-watchful dragon. Phrixos married the daughter of Æetes and settled in Colchis. He was father of Argus, builder of the ship ARGO. How JASON obtained possession of the fleece, with the help of the Princess MEDEA, and how he returned with it in triumph to Iolkos with his friends the ARGONAUTS, is told in other articles. After the delivery of the golden fleece to King Pelias by Jason we are surprised to hear no more of it.

GOLDEN FLEECE, ORDER OF THE. This, the most celebrated existing order of knighthood, except our own unrivalled Order of the Garter, was founded 10th January, 1429, by Philip III. of Burgundy. Like the orders of the Templars, &c., that of the Golden Fleece was nominally for the protection of Christianity; the epithet *golden* referring to the splendour which was intended to surround the new order, and the *fleece* alluding at once to the Lamb of Scripture and to the great wool industry of the duke's Netherlandish dominions. The promulgation took place at Bruges, in the Netherlands, on the occasion of the duke's marriage with the Infanta of Portugal. The motto of the order is *Pretium non vile laborum.* Flint enters largely into the composition of the insignia, as a flint formed the ancient arms of Burgundy, with the motto *Ante ferit quam flamma micet.* The collar of the Fleece is accordingly made of double steels interwoven with flint stones (or their representation in gold and enamel), in such a way that the curved sides of the steels make B's, the cypher of Burgundy. The flints are represented as emitting sparks. The badge hangs from the collar, or now more usually from a red ribbon, and is a sheep's fleece in gold suspended from a flint emitting sparks. The order was originally to contain but twenty-four knights, but this restriction has been long removed. The acquisition of the Netherlands by the Emperor Charles V. of Germany (Charles I. of Spain) gave the famous order into Spanish keeping, and its dignity was even enhanced by the change. No one but a grandee or noble of the highest grade can wear it, unless in quite extraordinary cases. When the great war of the Spanish Succession, in the time of Louis XIV., ended in placing the French Bourbon prince on the throne as Philip V., the Emperor Charles VI., to whom the Netherlands were surrendered at the peace of Rastatt in 1714 as the price of his withdrawal of his own claims on Spain, asserted that with the land of its birth the Order of the Golden Fleece had passed into the keeping of Austria. This Philip V. by no means agreed to; but notwithstanding his objection, Charles VI. at once inaugurated the Austrian branch of the order at Vienna. The Austrian branch has never been so strictly maintained as what one may call the original Spanish order.

GOLDEN LEGEND, a well-known popular collection of sacred tales compiled by a Dominican friar of the thirteenth century named James de Voragine or Vragine. Each section, of which there are 177, is devoted to an account of some saint or some festival of the church.

GOLDEN MOLE (Chrysochloris) is a genus of INSECTIVORA which, presenting a general agreement with the genus Talpa, of which our common mole is the type, yet differs from it anatomically in several respects. This genus is therefore usually removed from the family Talpidæ, and made the type of a distinct family, Chrysochloridæ.

The golden moles are confined to Southern Africa, ranging from the Cape of Good Hope to Mozambique. The Cape Golden Mole (*Chrysochloris capensis*) is the best known species. This animal is rather smaller than our common mole, being about 5 inches in length. The fur is of a brownish colour, capable of reflecting iridescent hues of green and purple, which change to a copper or bronze



The Cape Golden Mole.

tint. The body is short and stout, and destitute of a tail. The muzzle is short and broad, terminating in a slightly pointed and projecting nose. The eyes are covered by the integument; there is no appearance of an external ear, these organs being concealed beneath the fur. The total number of teeth is thirty-six or forty. The dental formula is

$$i.\ \frac{3\text{-}3}{3\text{-}3},\ c.\ \frac{1\text{-}1}{1\text{-}1},\ pm.\ \frac{3\text{-}3}{3\text{-}3},\ m.\ \frac{3\text{-}3}{3\text{-}3}\ \text{or}\ \frac{2\text{-}2}{2\text{-}2}.$$

A species, *Chrysochloris obtusirostris*, has only two molars on each side of each jaw: on account of some other peculiarities it is sometimes placed in a separate genus,

Calcachloris. The fore limbs are provided with four toes; the first is very small, but the second is large and armed with powerful claws: the phalanges of the third and fourth have coalesced to form a single gigantic digit, which forms a powerful digging and burrowing organ. The hind feet have five toes. The skull exhibits a more conical form than obtains in the true moles. The sternum differs in structure from that of the true moles; the clavicles and the scapulæ are long and thin. The humerus is comparatively longer than that of the common mole, and at the lower part it is not only articulated to the radius and ulna, but also to a third bone, specially developed to strengthen the arm during the action of burrowing. This strange supplementary osseous appendage represents one of the carpal elements of the wrist. The golden moles are similar in habits to the common moles.

GOLDEN NUMBER, so called from its having been formerly written in golden letters in the almanacks, is the year of the metonic cycle of nineteen years in which the current year falls. To find it, add one to the year of the Christian era and divide by nineteen, the remainder is the golden number of the year; but if there be no remainder then nineteen is the golden number.

GOLDEN ROSE, a rose formed of gold and anointed with rich perfumes, which is laid on the altar on Mid-Lent Sunday, after having been blessed by the pope. It is afterwards sent as a gift from the pope to some sovereign, church, or community which has been specially distinguished by acts of zeal for the church. If no one in any year is deemed worthy of the gift it is laid up in the Vatican. The only English monarch who ever received the golden rose was Henry VIII. He earned it by his pamphlet against Luther, as well as the title "Defender of the Faith," from Clement VII. (Medici).

GOLD'FINCH is the common name for the well-known and gaily plumaged songster, *Carduelis elegans* of ornithologists, belonging to the family FRINGILLIDÆ, of the order Passeres.

This bird is so familiar to most persons that a detailed description would be superfluous. The sexes are nearly alike, but the tints of the female are not so bright as those of the male. The young are clad in a comparatively simple plumage, in which brown predominates till their first change, and are then the "Branchers" of the London birdcatchers. The goldfinch inhabits most parts of Europe, and reaches as far east as Persia; it is also found in North Africa. This bird dwells during the spring and summer principally in orchards and gardens, but during the autumn and winter it frequents the fields in large flocks to feed upon the ripe seeds of thistles, dandelions, and other plants. The song of this bird is agreeable. The nest is a very pretty cup-shaped structure of moss, grass, fine roots, and twigs, often intermixed with other suitable materials, and lined with down, feathers, and hair. The eggs, which are four or five in number, are pale blue, marked with a few purple and brown spots and lines.

In captivity the goldfinch is prized more for its beauty, docility, and affectionate disposition, than for its song. It is frequently taught to perform a number of tricks.

Hybrids between the goldfinch and hen canary are not unfrequently to be seen in the shops of the London bird-sellers. The American Goldfinch (*Carduelis tristis*) is very similar both in plumage and habits to the European species. The eggs are nearly white. In Central Asia the place of the common goldfinch is taken by *Carduelis caniceps*.

GOLD'FISH (*Carassius auratus*), a species of fish of the family Cyprinidæ or CARPS. It is the *kin-yu* (or gold-fish) of the Chinese. It was first imported into Holland in the middle of the eighteenth century; hence it spread over the Continent. It had, however, been brought from China to England so early as 1611. It is a favourite domestic pet, and may be fed on bread, yolks of eggs, small insects, &c. Its water should be frequently changed. In a wild state in China and Japan it does not differ in colour from the Crucian Carp (*Carassius vulgaris*). In the domesticated state it is subject to a kind of incipient albinism, acquiring a bright orange or yellow colour: the shades of colour are very variable, and often a silvery white line is found, giving rise to the well-known silver-fish. Many monstrosities have been produced with several tails, very large fins, or no dorsal fin. The variety most prized is the telescope-fish, which has very large protruding eyes, no dorsal fin, and a very large-lobed caudal fin.

GOLD-SIZE, a kind of tenacious and quick-drying varnish, chiefly used by gilders to form the letters and other objects intended to be gilt by means of gold-leaf, which inseparably adheres to the varnish. It is also used for attaching bronze powders to objects intended to be decorated in that way.

The rationale of gold-sizing is this. As metals cannot well adhere by contact to any but other metallic substances, when gold is to be applied to the surface of some non-metallic body, as wood, leather, paper, &c., the surface must be previously covered with some sizy or viscid substance by which gold is made to adhere. These substances may be made of any vegetable or animal glue, or of oily, drying materials, and are usually called *sizes*. After the application of this size to the surface of any body, thin leaves of finely-beaten gold are spread upon it, and pressed down with a hare's foot. When the whole is dry the work in some cases undergoes the finishing or polishing process, by being burnished with a hard and smooth instrument. By the application of a gold-coloured size or varnish a very fine transparent colour is given to silver and brass, and all the brilliancy of the metal is shown beneath. Many brass ornaments are varnished in this manner, and the process is called *gold-lacquering*, to distinguish it from real gilding. It is very similar to the beautiful art of *japanning*, so extensively practised by the Japanese, Chinese, and other nations of the East.

GOLDO'NI, CARLO, the famous dramatist, was born at Venice in 1707, in the house of his grandfather, who was fond of the company of musicians and comedians, and thus Goldoni imbibed his theatrical tastes. He ran away from different colleges in order to join strolling players; and even after having taken the degree of doctor of law at Padua, and practised as an advocate at Venice, he employed himself as stage-poet to a company of actors, and thus spent some years. In 1742 he left them and began to practise as a lawyer at Pisa with great success; but again, on the appearance of another company, he resumed his occupation as a stage-poet, and commenced in earnest his long desired career as a reformer of the Italian stage, which was then chiefly characterized either by dulness or by licentiousness and absurdity. The only popular national species of play were the "commedie dell arte" or "à soggetto," in which a mere outline of the plot was sketched out, and the dialogue was delivered nearly extempore by the actors, but with certain fixed and popular characters, called Maschere, from the masks worn by the actors. The principal characters were a Pantalone, Arlecchino, Policinello, and a clown. These plays of course depended upon the mental resources of the actors; and their tendencies were towards both an immoral and an inartistic licentiousness. Goldoni, while often retaining the maschere in a subordinate position, raised his plays to the rank of regular comedy. His productions were very numerous; he wrote, at one time, sixteen plays in a single year. Notwithstanding the inequality of his works, he is confessedly the restorer of the Italian comedy. The species of popular play above spoken of found a powerful defender in Goldoni's time in Carlo Gozzi; and hence a great rivalry arose between the two. In 1761 Goldoni was invited to Paris by an Italian com-

pany, and there wrote many plays, some of which were in French, and he met with great success. His "Bourru Bienfaisant" remains a standard play in France. Voltaire praised him, and Diderot borrowed from him. He was now relieved from the poverty in which he had lived by an appointment as teacher of Italian to the daughter of Louis XV.; and, after some years of service, a pension of 3600 livres was granted him. This was taken away at the Revolution, but restored by the Convention in January, 1793. He died at Paris a few days afterwards. His complete works were published at Venice, in forty-four volumes 8vo (1794–95); he wrote his Memoirs in French, in three volumes. Copping's Life of him (London, 1857) is amusing and accurate.

GOLDSMITH, OLIVER, was born on the 10th of November, 1728, at Pallas, in the parish of Forney and county of Longford, in Ireland. He was the fifth of the seven children of the Rev. Charles Goldsmith, who had married while very poor, and only received his first preferment, the rectory of Kilkenny West, in 1730, two years after the birth of Oliver. The future poet received the rudiments of education from a village schoolmaster, Thomas Byrne; he was afterwards sent, at the expense of an uncle and of other relatives, to school at Athlone; then to Edgeworthstown, to prepare him for the University of Dublin, which he entered as a sizar in June, 1744. Here his indolence and extravagance, and the injudicious violence of his tutor, prevented his advancement, and he did not obtain the degree of B.A. until February, 1749, two years after the usual time. His father was then dead; but his uncle, the Rev. Thomas Contarine, fully supplied his place. By his advice Goldsmith applied for orders, but was rejected by the bishop, owing, it is said, to his having presented himself dressed in a scarlet suit. The situation of tutor in a gentleman's family was then taken, but soon thrown up in disgust. His uncle then furnished him with money to go to London to study the law, but on his way he lost all his money in gambling at Dublin, and returned penniless. His uncle forgave him, and sent him in 1752 to Edinburgh to study medicine; whence after two years he went to Leyden, to complete his medical studies. He resided there a year, studying chemistry under Gaubius, and anatomy under Albinus, but indulging much in dissipation. From Leyden he set out to make the tour of Europe on foot, trusting entirely to chance for support. A well-known passage in the "Vicar of Wakefield" is supposed to refer to this period—"Whenever I approached a peasant's house towards nightfall, I played one of my most merry tunes, and that provided me not only a lodging, but subsistence for the next day." He thus worked his way through Flanders, portions of France and Switzerland, and the north of Italy, whence he transmitted the first sketch of "The Traveller" to his brother. The news of the death of his uncle and benefactor caused him to return to England in 1756, after about twelve months' travel. In London he became an usher in a school; then an apothecary's assistant, until an old schoolfellow helped him to commence as a physician; and with this pursuit and literature he managed to subsist. In 1758 he lost an important medical appointment in India, through his rejection by the College of Surgeons. He next wrote for some months for the *Monthly Review*, under the management of Mr. Griffiths, the proprietor. Much of his time after this was spent in literary compilations, &c., for the booksellers. We shall only mention his chief works. In 1759 he published his "Present State of Literature in Europe;" in 1761, while under arrest for debt, he was freed by the sale of the inimitable "Vicar of Wakefield," for which Dr. Johnson obtained for him £60, but which was not published for some time afterwards. The "Traveller" appeared in 1764. His comedy of the "Good-Natured Man" was produced with but moderate success in 1768. The "Deserted Village" was published in 1770; and he then commenced his well-known histories of Rome, Greece, and England. On the establishment of the Royal Academy in 1770, Goldsmith became the professor of ancient history. "She Stoops to Conquer" was produced in 1773, with the greatest success. One of his latest publications was his "History of the Earth and Animated Nature," published in 1774, and for which he received £850. In the spring of 1774 he was taken ill with fever, which, aggravated by mental distress caused by the poverty and debt into which improvident habits had plunged him, and by a wrong treatment which his physician could not dissuade him from pursuing, ended fatally on the 4th of April. A monument to his memory was erected in Westminster Abbey, with an inscription by his friend Dr. Johnson, "He touched nothing which he did not adorn." The fullest and best biography of Goldsmith is that of Forster, entitled "The Life and Times of Oliver Goldsmith" (London, 1862).

GOLDSMITHS' NOTES were the originals of the now familiar bank-note. When Charles I. committed his famous act of royal embezzlement, and seized the £200,000 reserve of the London merchants lodged in the Tower for security (an act which when imitated by private persons in our days rightly sends them to prison), men felt that the royal word could no longer be taken, and that the money was safer anywhere than in the possession of the chief magistrate of the realm. Consequently for ever after the cash was deposited with the goldsmiths to obtain the advantage of their strong rooms, &c. The goldsmiths proved themselves better and more honourable custodians than the king. The form adopted was for the goldsmith to give a receipt or receipts for the money, and these receipts were passed from hand to hand like bills of exchange. Or a merchant would draw upon his store by a note to the goldsmith (cash note). Or finally, instead of a receipt the goldsmith would give a promissory note, or notes for the amount received. Both these forms of notes of course could pass from hand to hand. Thus the modern cheque and the modern bank-note were clearly foreshadowed. Few specimens still exist. The earliest known notes are dated 1684. The Bank of England was not founded till 1694.

GOLF, a game which is almost as national in Scotland as cricket is in England. Within the last few years it has been introduced south of the Tweed, and the old metropolis of golf, St. Andrews, has found a rival upon the sandy "dunes" that break for a while the towering cliffs of the North Devon coast-line, and the sights and sounds that for generations have been connected with the breezy shores of the Lothians and Fife are now almost as familiar to the frequenters of Wimbledon and Blackheath. It is played on downs or meadows, by either two or four gentlemen. Clubs of various sizes with heavily weighted heads are used, and gutta-percha balls painted white. A series of small round holes, about four inches in diameter and the same in depth, are made in the turf, at distances of from 100 to 500 yards from each other, so as to form a circle. The famous links of St. Andrews are a stretch of sand and "bent" grass between the town and the estuary of the Eden. There are eighteen holes arranged at distances varying from 100 to about 400 yards, and the course, as it should be driven over by a fair player, is supposed to be as nearly as possible 4 miles. The game is to drive the ball from one hole to the other round the circle with as few hits as possible. The player whose ball is sent into the hole with the least number of strokes has gained that hole, and the winner is he who gains the greatest number of holes in one or more rounds, though the match is sometimes made to depend on the aggregate number of strokes taken in gaining the holes once or twice round the course.

The game of golf is of such remote antiquity that its origin is matter of dispute with archæologists. Some of

them maintain that it was introduced from Scandinavia or Northern Germany, though the sport must have been carried on under difficulties in the forests and swamps of the barbarous North. Be that as it may, it has never been played out of Scotland in historic times, except in one or two of the English and American colonies, while from the first it acclimatized itself naturally on the Scotch soil. Scotland was, in fact, the very country for it, with those broad bare links of sandy turf, broken by patches of scrubby furze and protected from the sea by lines of sand-hills. Ancient the game undoubtedly is, but there was a time when it had little favour from royalty. In the fifteenth century it had become so popular as to be proscribed under penalties by Acts of Parliament, as interfering with the practice of the people in archery; 150 years later we find the clergy denouncing the game on different grounds. Their parishioners would insist on desecrating the Sabbath by toiling after golf balls on the day of rest, and some offenders were cited before the kirk sessions to be dealt with summarily by way of example. King James VI., though the most religious of monarchs, held broader views, and it was in his reign that the game may be said to have become royal.

With the fall of the native Stuart dynasty the association of royalty with golfing ceased, till in 1834 William IV. became patron of the St. Andrews Club, conferring on it the style of "Royal and Ancient," and in 1863 the Prince of Wales consented to fill the same dignified office.

GOL'GOTHA, the Hebrew name of the place which was the scene of our Lord's crucifixion. The name is interpreted by Matthew, Mark, and John as meaning "the place of a skull," but Luke refers to it as "the place which is called, The skull." The Latin equivalent of the word is *Calvaria, i.e.* a bare skull, whence the word Calvary, adopted in the Authorized Version. Two explanations of the name have been suggested: (1) that it was probably the ordinary spot used for executions, and that the skulls of the malefactors were left there. Or (2) that it was a rocky mound or hillock having a bare round appearance resembling the dome of a skull. The latter interpretation would give some warrant for the common phrase "Mount Calvary," which, however, rests upon no Scriptural authority.

The place now shown at Jerusalem as the site of Golgotha is that which is covered by the Church of the Holy Sepulchre, where a spot having three holes is pointed out as the place where the crosses were planted. A church was erected over the site of Golgotha in the fourth century by Constantine, but the building now shown has no claim to be considered as that which was built by that emperor. Some strong reasons have been advanced in favour of the building known as the Mosque of Omar and the place called "The Dome of the Rock," but the question is veiled in much obscurity. Dr. Robinson, Dr. Thompson, and other scholars are of opinion that so many changes have taken place in the neighbourhood of Jerusalem as to cause the true sites of the crucifixion and sepulchre to be for ever unknown.

GOLI'ATH BEETLE is the name given to some species of ROSE-CHAFERS (Cetoniinæ), a subfamily of the extensive family Scarabæidæ. The species to which this name is applied are all tropical; they are distinguished by their large size and by the horny processes with which the heads of the males are furnished. The food of these beetles is liquid, consisting of the sap of plants. They have been found on trees 30 or 40 feet high. Like all the rose-chafers the Goliath beetles are remarkable for the splendour of their colours. In the British Museum is a specimen of the cocoon of the *Goliathus druryi*, with a strong raised ledge which nearly surrounds it, and not only helps to strengthen it, but also keeps it from rolling too far should it fall. *Goliathus druryi* is the largest species known; it is a native of the Gold Coast. The natives of Western Africa eat these beetles, which are said to be very fat and sweet.

GOLOSH'ES, or caoutchouc overshoes, were first made in America. They are composed of vulcanized india-rubber, are elastic and easily put on over boots, and are impervious to wet. The process of making goloshes consists in preparing the raw material by washing and rolling; kneading it up with certain chemicals, by passing it through hot rollers; converting it into thin sheets of several yards in length, cutting out the various parts by machinery, cementing them together by hand, varnishing, and baking or rather vulcanizing. Goloshes were at first imported solely from America, but there are now many large factories engaged in the manufacture in England. The word golosh, as a name for a covering for the feet, has undergone many changes of meaning. A *galocha* was originally a Spanish wooden shoe or clog; then *galoche* was a French shoe, with a leather upper and a wooden sole; then a *galosh* was an English shoemaker's name for a strip of leather applied as a strengthener around the lower part of the upper leather; and afterwards *galosh* or *golosh* was the name given to a superior kind of clog for women.

GOMU'TO PALM. See ARENGA.

GON'DAR or **GUENDAR,** a town of Abyssinia, is situated in 12° 36′ N. lat., and 37° 32′ E. lon., not far from the northern border of the plain which reaches from the northern shores of Lake Tzana to the table-land of Wogghera. It stands between the Angerab on the east and the Gaha on the west. The town covers a considerable space of ground, but the larger portion at present consists of ruins or tracts overgrown with canes. The inhabited portion does not consist of one continuous mass of buildings, but of seven isolated groups of buildings, lying at some distance from one another. The largest of these groups lies on the western side, and is only inhabited by Mohammedans; hence it is called Islambad, and not far from it is Etshegbebad. These two quarters contain half the population of the town. Over this space, and mostly among the ruins, a great number of churches are dispersed. The houses have the shape of a cylinder, with a conical roof of straw. They are built of volcanic stones in their natural condition, and they are cemented by a loamy earth. To the north of the town stands the palace of the emperor or Negus, which was built by Fasilidus in the seventeenth century. It is surrounded by a high wall surmounted by embrasures, and contains a courtyard and several large buildings, now in ruins, except one of moderate size, in which the late emperor resided.

Gondar was formerly the capital of the Amharic kingdom, and was founded in the fifteenth century by the Emperor Fasilidas or A'lem Seged. It was laid in ruins by Theodore in 1868. The inhabitants are largely employed in making cotton cloth, gold and silver ornaments, copper wares, fancy articles in bone and ivory, saddles, and shoes, which are chiefly worn by the clergy. The number of houses in Gondar is about 1000, and the population 6500.

GON'DOLA is the name given to the pleasure-boats at Venice, which are very numerous, and serve, in its canals, for persons of all classes to proceed from one district to another. The gondola is shallow, long, and narrow, looking, as Byron describes it, like a coffin in a canoe, owing to the black curtains, &c., of the cabin in the centre. The *gondolieri* once formed an important corporation, several thousands in number, and were distinguished for their wit as well as for their skill and honesty. The number of gondolas has decreased in consequence of the introduction of steamboats on the Grand Canal in Venice. The word gondola does not occur till the twelfth century, and then not at Venice but at Avignon. The derivation of the name is still an open question; but the view which has obtained the most general acceptance is that which connects the

word, with the Latin *cymba* and the Greek *kumbē*, the light boat in which Charon ferried souls across the Styx. Charon's boat, as it is represented on gems and marbles, resembles the barchetta, and Charon himself uses a paddle to guide his boat behind. The word gondola occurs for the first time as the name of a Venetian boat in the ancient *Chronicle of Altino* (about the year 1200), where we learn that the Patriarch of Grado enjoyed all the rights of shooting and fishing in the lagoons beyond Torcello, and the inhabitants were bound to furnish him with boats and gondolas. Gondola, therefore, was probably the generic Venetian name for all boats of the barchetta build, and remained attached to that particular barchetta form which subsequently emerged as the modern gondola. With the help of illuminated manuscripts, designs and plans of Venice, engravings and pictures, we can trace the development of the barchetta into the gondola. The earliest picture of a gondola, or rather of a barchetta, dates from the fifteenth century only. The next illustration of a gondola which we have bears the date of 1486. The gondola and its oarsmen have a little volume all to themselves, from which the above particulars of the craft are drawn—Mr. Horatio F. Brown's fascinating "Life in the Lagoons" (London, 1884).

GONG, a Chinese and Indian musical instrument of percussion, made of a mixed metal of copper and tin, in form sieve-like, much like the cover of a large culinary caldron, being circular, varying from about 15 to 20 inches in diameter, and having a rim of from 2 to 3 inches in depth. It is struck by a drumstick, the head of which is of padded leather. It is a very powerful instrument. The best gong-metal has 80 parts of copper to 20 of tin, cast to the required shape, then heated strongly, and when hot plunged into cold water and thoroughly hammered. This treatment gives the remarkable tone. Gongs are used occasionally in the orchestra for sombre and weird effects. Gossec first used them in this manner at the funeral of Mirabeau, 1791. A more humble use has lately come into fashion, whereby the gong serves instead of a dinner bell in large houses. It certainly is as well heard, and is much more distinctive in tone. A roll (like a drum roll) on a gong, rapidly crescendo, and ending with a stroke at full force, is the most effective way of using the instrument. The effect is really grand upon a full-sized genuine Chinese gong.

GONGON'HA, a species of Paraguayan tea extracted from the leaves of a species of holly, the *Ilex Gongonha*. It is much used in Brazil.

GONIATI'TES is a genus of fossil cephalopods, belonging to the family Ammonitidæ, of which the genus Ammonites is the type. In this genus the shell is disc-shaped, the sutures lobed, and the siphuncle is dorsal. Nearly 200 species are known, chiefly Palæozoic, ranging from the Upper Silurian to the Trias.

GONIOM'ETER is an instrument employed for the determination of the angles which the faces of crystals make with each other. These angles being constant within narrow limits for each mineral species, their exact measurement is of much importance, as from it not only the crystallographic system and form may be ascertained, but also the precise mineral species.

Goniometers are constructed on two different principles; in the one the inclination of the faces is ascertained directly by striking two jointed blades over the edge of the crystal, and at right angles to it, then when clamped in position, the angle thus obtained can be measured off by a protractor. These are the contact or direct goniometers, of which Carangeot's, which was used by Haüy at the end of the last century, may be taken as the type. In the indirect or reflecting goniometers the inclination of the faces is determined by ascertaining the angle through which the crystal must be turned in order to obtain the reflected image of an object successively in both faces. Of this type there are many forms, the most simple and one of the earliest being Wollaston's. modifications and improvements in the adjustments of which give rise to most of the subsequent forms.

In Wollaston's goniometer the unavoidable error in measuring the angle is less than the possible variation of the crystals themselves. Babinet's goniometer has the advantage of the divided circle being horizontal, so that the crystal operated upon is placed upright, and the readings made through a telescope; the most improved form of this instrument is that of Fuess of Berlin, which is capable of the most precise adjustment. O'Reilly's goniometer is a portable and compact instrument; it is about the size of a large pencil, the graduations being on a spiral wound round a cylinder, and the crystal placed on the principal axis; it gives good results; under favourable circumstances measurements can be relied upon to within a degree, and being so compact, it forms a valuable adjunct to the blowpipe for the determination of minerals.

For the adjustment and manipulation of goniometers, which cannot be clearly explained without diagrams, the student must consult the larger works on mineralogy.

GONIOM'ETRY, the measurement of angles; a little used term which, however, should be substituted for Trigonometry (measurement of triangles), if it were advisable to alter established designations. What is called trigonometry is, strictly speaking, goniometry.

GONORHYN'CHUS is a genus of fishes belonging to the order Physostomi, and forming the family Gonorhyncidæ. Only one species is known, *Gonorhynchus greyi*, a marine fish found off the Cape of Good Hope and in Australian and Japanese seas. This fish, the sand-eel of the New Zealand colonists, is about a foot in length. The body is covered with small spiny scales. The mouth is provided with barbels. The dorsal and anal fins are short; there is no adipose fin. The air-bladder is absent.

GONZA'GA, an historical family of Italy, claiming descent from the Emperor Lothar, and taking their name from their native village. Luigi Gonzaga, who was appointed podesta of Modena in 1313, became captain-general on the murder of his patron Bonacossi, lord of Mantua, in a conspiracy in which Luigi was concerned; and the year after the Emperor Louis of Bavaria made him imperial vicar of that city, of which the family became henceforward the hereditary rulers. A century later the head of the family assumed the title of Marquis of Mantua. During the war waged by the Italian league to drive the French under Charles VIII. from Italy, Gianfrancesco Gonzaga was at its head, and defeated the French at the battle of Tornovo, on the 6th of July, 1495. He was also present at the battle of Atella, and contributed to restore the Arragonese dynasty to the kingdom of Naples. When Louis XII. again invaded Lombardy, Gonzaga was compelled to do homage to him. His son Federigo, for his services against the French, was made Duke of Mantua by the Emperor Charles V., and obtained also in 1536 the marquisate of Monferrato. Federigo's brother, Ferrante Gonzaga, was made by the emperor governor of the Milanese, and he founded the line of the dukes of Guastalla. Guglielmo, Federigo's son and successor, was hump-backed. He was a good prince, and cherished learning. His son Vincenzo shared in these views, and obtained the release of Tasso from the Duke Alfonso d'Este. He it is who is charged with the murder of his preceptor, the Admirable Crichton. He died in 1612. Francesco, his son, exerted himself to repair the errors of his father's rule; he died soon after his accession, and was succeeded by his brother, Cardinal Ferdinando Gonzaga, and he by a third brother, Vincenzo, in 1626, at whose death, in 1627, the direct line became extinct. The ducal throne was then claimed by Charles,

duke of Nevers, son of Louis, brother of Guglielmo the hump-backed, and also by Charles' cousin, Gonzaga, a descendant of Ferrante Gonzaga (before named). Their dispute induced the Duke of Savoy to invade Monferrato, while the Emperor Ferdinand II. invaded Mantua as an imperial fief. Louis XIII. took the part of the Duke of Nevers, and thus a European war broke out. The French stopped the proceedings of the Duke of Savoy; on the other hand, Mantua was taken and pillaged, and its treasures of art dispersed. By the treaty of Ratisbon, 1630, peace was made, and the Duke of Nevers established both in Mantua and Monferrato. In 1635 he seized the principality of Correggio. He died in 1637. His grandson Charles succeeded. He was weak and dissolute, and he died in 1665, leaving an only son, Ferdinand Charles, under the guardianship of his mother. Ferdinand proved weaker and more dissolute even than his father. On the breaking out of the war of the Spanish Succession he allowed the French to garrison Mantua, and was put under the ban of the empire as a traitor; and when the French left Italy, the Austrians took Mantua and annexed it to the Milanese. Ferdinand, having thus lost his dominions, retired to Padua, where he died in 1708, without issue. He was the last duke of Mantua. All the other lateral branches also became extinct or dispossessed.

GONZA'LO, HERNAN'DEZ, DE COR'DOVA, surnamed the Great Captain, was born at Montilla, near Cordova, in 1453. After various minor services he aided in the defeat of the Portuguese at Albuera, and in the ten years' contest which ended in the conquest of Granada he played an important part. When Charles VIII. of France conquered Naples in 1495, Gonzalo was sent by Ferdinand the Catholic to expel the invaders, which he did with wonderful rapidity. He then received the name of the Great Captain from friends and foes. Gonzalo next aided the pope against one Menoldo Guerri of Biscay, who, having received Ostia in trust from Charles VIII., distressed and starved Rome. Gonzalo stormed the fortress, brought Menoldo in chains to Rome, where Gonzalo obtained his pardon, and then, with a hint to the pontiff as to a reformation of his household and court, retired to his own country in 1498. Two years later he suppressed a revolt of the Moors, and obtained their pardon also as the reward of his victory. Charles VIII.'s successor, Louis XII., again strove to obtain possession for France of Milan and Naples. Ferdinand of Spain now agreed to share in the spoils. Gonzalo was sent to aid the Venetians, and Cephalonia was taken from the Turks in 1500. The King of Naples was deposed, and the pope sanctioned the act. The partition of Naples soon brought the Spanish and French into collision, when Gonzalo drove the French out of the country, and reconciled the natives to Spanish rule. Ferdinand at last grew jealous of such brilliant successes, and removed him from Italy in spite of the desires of the Italians. On his return he was almost worshipped by his countrymen, while treated with contumely by the king for whom he had done so much. He was kept in idleness; and even when the king's fears were aroused after the victory of Gaston de Foix over the new viceroy of Naples in 1512, and Gonzalo had been requested to organize an expedition, when all was ready the king's jealousy overmastered his fears, and he ordered the disbanding of the forces. Many of the volunteers had parted with all their property to prepare themselves; and Gonzalo, forgetting the bitterness of his own disappointment and humiliation, rewarded them in a princely style. He then wrote to the king a letter of bitter complaint. He died 2nd December, 1515.

GOOD BEHAVIOUR is in legal phraseology generally synonymous with keeping the peace. Thus a person who has committed an assault, or who has threatened or provoked another, may in addition to the penalty inflicted be required to give security for good behaviour. To do this he is required to enter his recognizances with one or more sureties, or simply by himself, to pay a certain sum to the crown unless he is of good *abearance* for a stated time.

GOOD FRIDAY, the Friday before Easter Sunday, is the name given to the day of our Saviour's crucifixion. From the earliest ages of Christianity it has been held as a solemn fast. It is in England only that it is known by the appellation Good Friday; its ancient and appropriate title is Holy Friday. In the Roman Catholic Church the services of this and the preceding day are very striking. At mass the priests are robed in black, the altar is stripped of its decorations, and everything is done to increase the solemnity of the occasion. At the office of *Tenebræ* (darkness) all the lights except one are extinguished, one after another, a psalm and an antiphon being sung before each extinction. This is in reference to the supernatural darkness at the crucifixion. The single light is for a time hidden under the altar, as a symbol of our Lord's death and burial, and a solemn silence observed, which is suddenly succeeded by a loud noise, in token of the rending of the temple veil and of the convulsions of nature. The adoration of the cross, or creeping to the cross, is another part of the ceremonial; a large crucifix is placed upon the altar, and the entire congregation draw near, and, kneeling reverently, kiss the figure of the Redeemer. Good Friday is also celebrated in the English Church with special solemnity, the Ritualistic party closely imitating the ceremonial of the Catholic Church. A sermon used to be preached at St. Paul's Cross, at which the lord mayor and aldermen attended in their robes. Cakes made with the mark of a cross upon them form the general breakfast on Good Friday, but the practice has lost its religious significance. Cross-buns are supposed to have originated in the desire of marking on the only food anciently allowed on this fast-day a symbol of the crucifixion. In England the day is observed by a total suspension of business, but in Scotland it is only observed by Episcopalians and Catholics.

GOOD HOPE, CAPE OF. See CAPE OF GOOD HOPE.

GOOD PARLIAMENT, THE, a title of honour given to the Parliament of 1376, because of its attempt under the Black Prince, to end abuses and initiate reform. It impeached Lords Latimer and Neville and some commoners for having bought up the king's debts for purposes of extortion, and on conviction imprisoned, fined, and banished them. This is the grand precedent for impeachment of the king's ministers for evil conduct. This Parliament also made a strong stand against *purveyance*, or the right of the crown to buy at its own price whether the owner agreed to it or not. The death of the Black Prince, and the return of John of Gaunt to power, put an end to the efforts of the *good parliament*; but the people long remembered it and enshrined their memory of the feeling which inspired it in this honourable epithet.

GOOD-CONDUCT PAY is an addition made in the English army to the daily pay of corporals and private soldiers whose names have not been entered in the regimental defaulters' book. The amount given at one time is 1*d.* per day, with a stripe of white or gold braid to be worn on the arm as a badge of distinction. In all cases two years of uninterrupted good conduct immediately before the award being granted is required. Thus the successive awards of good-conduct pay may raise the wages to 6*d.* a day extra, with a corresponding number of stripes.

Non-commissioned officers have an addition of 2*d.* per day to their regular pay, in lieu of good-conduct pay; and a sum of money, about £4000, is annually distributed among sergeants of long service and good conduct as annuities of not more than £20 each. This is given during active service, and after retirement.

In the navy similar awards are made, the only difference being that the stripes are limited to three, and the good-conduct pay to 3*d.* a day. Petty officers may receive it, but the good behaviour which it evidences is not taken into account when considering the pension on retirement.

GOODENO'VIEÆ, a small order of plants, chiefly inhabiting Australia and Polynesia, and in that region representing the Campanulaceæ of the northern hemisphere. They are in fact so nearly allied to the tribe Lobelieæ that they can scarcely be said to differ in anything of importance. The following are the general characteristics which distinguish the order from others in the cohort Campanales of GAMOPETALÆ:—The flowers are generally irregular; the corolla is induplicate-valvate; there are five stamens; the stigma is surrounded by a cup-shaped structure, which closes over it after fertilization; the ovary is one or two-celled, with one or several ovules; the fruit is a drupe, berry, or capsule; the species are herbaceous, rarely shrubby. Twelve genera are all that this order contains. The prevailing colour of their flowers is yellow, and some of them are sufficiently handsome to be worth cultivation. Some few of the plants are eaten, or are otherwise useful. The leaves of *Scævola Taccada* are boiled as a pot herb, and the pith furnishes a kind of rice-paper.

GOODS and **CHATTELS,** in law, is a phrase used to signify things personal as distinguished from things real, lands, tenements, and hereditaments. When used in wills it generally includes the personal property of the testator.

GOODWILL' is used in trade to describe the advantage or benefit which is acquired by a business beyond the mere value of the capital and stock, in consequence of its acquiring a number of regular customers and a good reputation. Formerly its existence was not recognized by itself in law, and the sale of "the goodwill of a business" without something more was a mere nullity, but now under some conditions it is the subject of sale and is personal estate. In the sale of the goodwill of a business it is implied that the vendor is to do all in his power to recommend the purchaser and to promote the interests of the business. He must not commence a new business using the style or name of the old firm, nor can he hold out to the customers or the public that he is carrying on business in continuation or succession to the old firm. But the sale of the goodwill of a business will not prevent the seller setting up a similar business in the neighbourhood, even next door to the buyer, and appealing to the same customers, unless he has entered into an agreement not to do so. Hence it is usual to define a distance within which the vendor promises not to carry on a similar business, and such a covenant is recognized and can be enforced by law.

GOOD'WIN SANDS, THE, are about 6 miles from the east coast of Kent. They are about 10 miles in length, and of an average breadth of 3 miles. They are divided into two portions by a narrow channel, and may be seen above the surface at low water. Three light-vessels are placed respectively at the north, centre, and south of the sands, to mark the boundaries of this dangerous shoal. The Goodwin Sands are constantly shifting, and charts require frequent rectifying to secure accuracy. When gales are blowing from the east or south-east the sands serve as a breakwater to form a secure anchorage in the Downs; but when the wind blows strongly off the shore, ships are apt to drag their anchors and to be cast upon the Goodwin shifting sands. In 1846 a lighthouse was built on piles of iron driven into the sand, but it was soon washed away, and all attempts to fix a beacon have failed. Numerous wrecks have taken place here, notably those of the *Stirling Castle*, *Mary*, and *Northumberland*, which with ten other warships were lost on the 26th of November, 1703; the *Aurora*, a transport, in 1805; the *British Queen*, in 1814; and the *Violet*, a mail-steamer, in 1857. It is believed these sands were once part of the mainland, and formed a portion of the estate of Earl Godwine.

GOOLE, a market-town and river-port of England in the county of York, West Riding, 30 miles south-west from Hull, is situated on the south bank of the river Ouse, at the mouth of the Don, and connected with the Great Northern Railway, by which it is 187½ miles from London. It is the terminus of the Goole and Knottingley Canal, 18 miles in length. A short distance north of Goole the Ouse is crossed by the Skelton viaduct of the North-eastern Railway, completed in 1869, one of the most remarkable works of the kind yet constructed. The Ouse is here 800 feet wide, and the bridge is of seven spans, but to permit the passage of ships the centre portion is made to turn upon an immense mid-river pier. The movable part is 232 feet long, longer than anything of the kind in England, but is turned with the greatest ease by hydraulic power. Goole is now a busy and important harbour, pier and docks having been constructed by the Aire and Calder Navigation Company. The wet docks consist of the sailing-ship dock, 600 feet by 200, with 18 feet of water, the railway dock, 700 feet by 200, and the steamship dock, 900 feet by 150. There are also large warehouses. Steamers ply regularly between Goole and Hull, Antwerp, Dunkirk, Rotterdam, &c. The trade of the port is steadily increasing. Iron, cloth, and building stone are the chief exports, fruit and vegetables the principal imports. Shipbuilding, boatbuilding, iron-founding, and sugar-refining are among the staple resources of the town. The church is of modern construction, with a lofty spire. The population of the town in 1881 was 4823. The number of vessels registered as belonging to Goole in 1884 was 290 (24,000 tons). The entries and clearances average 2000 (450,000 tons). The customs revenue in 1883 was £22,200.

GOOS'ANDER. See MERGANSER.

GOOSE (Anserinæ) is a subfamily of Anatidæ. As a general rule the Anserinæ are far less decidedly aquatic than the swans (Cygninæ) or the ducks (Anatinæ and Fuligulinæ). The geese are grazers; all are gregarious in their habits and more or less migratory. The beak is strong, and more or less conical, covered with a coriaceous skin, with the exception of the nails (*dertra*) of the upper and lower mandibles. The edges of the mandibles are lamino-dentated; the lamellæ of the upper mandible exposed, those of the lower mandible covered by the projection of the upper one. The nostrils are lateral, placed rather behind the middle of the bill, and pierced in the lower and front part of the membrane that covers the nasal furrow. The tongue is broad, fleshy, and fringed. The wings are long, ample, and tuberculated.

The Anserinæ appear to be all migratory; those at least belonging to Europe and North America are so. In the beginning of spring they travel in long lines to the desert regions of the north, where they mate in pairs and rear their broods; in autumn they commence their journey southward.

Of the European species we may enumerate the following:—The Gray-lag Wild Goose (*Anser ferus*); the Bean Goose (*Anser segetum*) [see BEAN GOOSE]; the White-fronted Goose (*Anser albifrons*); *Anser erythropus*, very similar to the former species, but not occurring in England; the Pink-footed Goose (*Anser brachyrhynchus*); the Barnacle Goose or Clakis (*Anser bernicla*, or *Bernicla leucopsis*) [see BARNACLE GOOSE], common to Europe, Asia, and North America; the Brent Goose (*Bernicla torquata*), common to Europe and North America; the Red-breasted Goose (*Bernicla ruficollis*), a native of North-eastern Asia, occasionally straying as far as Britain; the Snow Goose (*Chenalopex hyperboreus*), a native of Northern Europe and the regions of America.

To these we may add the Egyptian Goose (*Chenalopex ægyptiaca*), found in South-eastern Europe, and also in North America; the Cereopsis Goose of Australia [see

CEREOPSIS]; the Spur-winged Goose of Northern and Western Africa (*Plectropterus gambensis*); the Bar-headed Goose of India and Central Asia (*Anser indicus*); and the Chinese or Guinea Goose (*Anser cygnoides*, or *Cygnopsis cygnoides*), from Eastern Siberia or Mongolia.

North America possesses some species peculiar to itself, as the Canada Goose (*Anser canadensis*) and the *Anser hutchinsi*; and species of the genus Chlœphaga, as the Rock Goose (*Chlœphaga antarctica*) and the Upland Goose (*Chlœphaga magellanica*).

To enter into a detailed history of all the species which we have enumerated is, in a work like the present, impossible; yet a slight sketch of one or two of the most interesting may be admissible. The undoubted original of the domestic goose is the Gray-lag Goose (*Anser ferus*). This bird, before our great marshes were drained, bred regularly in England, but is now of rare occurrence, and is only met with in small flocks during the winter. In some parts of Scotland it occasionally breeds. On the Continent its geographical distribution extends over the central and eastern parts of Europe, Northern Asia, and some parts of Western Africa, where it inhabits the marshes and the borders of lakes and inland seas. It makes a coarse nest amid rushes, &c., and lays from five to eight eggs of a dull or dusky white. It is very watchful; and while the flock are feeding sentinels are stationed so as to command an extensive view, and these, on the slightest appearance of danger, utter a loud cry of alarm, upon which the whole flock takes to wing with incredible alacrity. They generally fly at a great elevation, either in single file or in the form of the letter V, the leader being occasionally changed. Their resting-place at night is either on the water or on some sandbank, at a distance from the shore; but even then the safety of the flock is watched over by sentinels, as it is during their feeding time.

With respect to the domestic relative of the Gray-lag little need be said. It has been domesticated from a very early period, for it is mentioned in the Odyssey of Homer. Geese were sacred to Juno, and on one occasion the sacred birds, which were tended in the temple of the goddess on the Capitol, saved the fortress by their vigilance from the attack of the Gauls. Darwin remarks that "hardly any other anciently domesticated bird or quadruped has varied so little." It has increased in size and productiveness, and it has lost the darker tints of the wild bird, its plumage always tending to white, and being frequently wholly of that colour. The liver of the goose seems to have been esteemed by epicures in all ages; the Strasburg *pâté de foie gras* is not more in request now than were the great-goose livers in the time of Pliny.

The goose is valuable, not only for its flesh, but for its feathers also, and the system of plucking these birds alive is not obsolete. It would seem that they are usually plucked five times a year, first at Lady Day for feathers and quills, and afterwards at intervals to Michaelmas for feathers only. The quills before the introduction of steel pens were in universal request.

The White-fronted Goose (*Anser albifrons*), a rather smaller species than the preceding, is distinguished by having a white band at the base of the upper mandible, continued in the form of a patch on the forehead; it is an inhabitant of the whole northern hemisphere, and is an abundant winter visitor to this country. Its note somewhat resembles a laugh, and hence it has sometimes been called the Laughing Goose.

The Canada or Cravat Goose, a beautiful species, of which numbers have been reclaimed, invites notice as a link between the geese and the swans, and the same observation applies to the Chinese Goose (*Anser Cygnoïdes*). Both these birds are kept as ornaments on our lakes and sheets of water.

The Egyptian Goose (*Chenalopex ægyptiaca*) requires a passing notice, not only on account of its exquisite colouring, but because it was a sacred bird among the ancient Egyptians, who have left on their monuments its sculptured effigies in abundance. It is common on the banks of the Nile, and indeed is distributed over the whole of the vast continent of Africa. This handsome species breeds freely in confinement, and is often seen in aviaries and on the ornamental ponds of those who take pleasure in collecting choice specimens of water-birds. It might be easily added to our list of domestic poultry. Its Greek name, Chenalopex (goose-fox), refers to its watchfulness and cunning.

GOOSE'BERRY, the *Ribes Grossularia*, indigenous to Britain and other European regions of cool temperature, is the origin of the many hundreds of kinds of this wholesome fruit now in cultivation. Some authors refer the varieties to two species, *Ribes Grossularia* (the rough gooseberry) and *Ribes Uva-crispa* (the smooth gooseberry). Others consider the latter as being merely a variety of the former; and certainly this is most correct, since it has been proved, from the results of successive reproductions, that the rough will sometimes become smooth, and the contrary. The name gooseberry is a corruption of *groseberry*, from the French and Latin name, added to the English "berry." The French name, *groseille à maquereaux*, also may indicate another application as a sauce. The English name, *Feaberry* or *Feabes*, was given for its medicinal use in fevers during the middle ages. The gooseberry will ripen in the extreme northern parts of Britain, near the level of the sea; and in lat. 57°, even at an elevation of 900 feet, it acquires great perfection with regard to flavour.

It appears that the flavour is best where the low temperature of the north brings the fruit more gradually to maturity than it does in the south, where the fruit is in danger of being scorched, and where it ripens far too quickly to acquire the peculiar flavour which it attains in its favourite climate; and a different method of pruning and training ought to be practised accordingly. Thus, in the north the branches should be left thin, so as to expose the fruit, and with the same view the spurs should be short. In the south the trees should not be laid so open, and the lateral young shoots, instead of being cut close in immediately above the fruit-bud at their base, should have two buds left to produce leaves for shading the fruit in summer.

The gooseberry is not mentioned by the Greeks and Romans, for although it does occur rarely in the mountainous districts of the south of Europe, it is not worth cultivating. In the north of Africa it is found in Algeria in the Mountains of Aurès, and in Morocco in the Atlas Mountains. It also exists in the Caucasus, and in the Western Himalaya.

The pruning of gooseberries is performed any time during the winter, and before the sap begins to be in motion in the spring. The operation consists in removing all cross laterals, so as to leave the branches as nearly as possible at regular distances round an open centre, except where the heat of the climate renders it necessary to retain branches in the centre for shade; and the points of these branches, where too extended or weak, should also be shortened to some well-situated bud. Very strong shoots, assuming the character of robbers, should be cut clean out, except such as may be occasionally wanted to supply vacancies. It is, however, better economy, with regard to the health of the tree, to pinch off the tops of these strong shoots in the summer, and thus prevent their monopolizing the sap from the other parts. Suckers, on the same principle, should be prevented from growing at the root.

The branches in all cases should be pruned to a single terminal shoot. In short, the plant should exhibit a regular appearance, without any overcrowding in one part and deficiency in another.

GOOSE'BERRY CAT'ERPILLAR is the grub of the Magpie Moth (*Abraxas grossulariata*), one of the Geometridæ or Loopers. This moth is less than the common butterfly. Its colour is black and white, the black mixed with orange occurring in spots and blotches, the white forming the ground. It undergoes a perfect metamorphosis, from egg to caterpillar, then to pupa, and last to the perfect insect. The grub is black and white; the pupa case is black, with four transverse bands of white. The eggs are deposited on the leaves of gooseberry and currant bushes, which the grubs frequently strip bare; the growth of the berry is thus interfered with, the juicy secretions stopped, and the fruit kept small and acrid. The best remedies are found in washing the bushes with hellebore, or in spreading quicklime around them in autumn and spring, preparatory to the digging of the ground at both seasons. Hand-picking is, however, the most effectual mode of getting quit of this garden pest. The gooseberry bush also suffers much from the larvæ of one of the saw-flies (*Nematus grossulariæ*). These larvæ are of a green colour, shagreened, as it were, with minute black tubercles, which they lose at their last moult.

GOOSE-GRASS. See Galium.

GO'PHER (*Testudo gopher*) is the sole representative in North America of the land tortoises (Testudinidæ); its range extends from Florida to the river Savannah. The gopher is nocturnal in its habits, seeking its food by night and concealing itself in its burrow during the day. The sweet potato is its favourite food. The strength of these tortoises is enormous. The carapace is about a foot long, oblong, and compressed.

GO'RAL (*Nemorhædus goral*) is an Antelope inhabiting the Himalayan range. The goral resembles greatly a goat; the back is somewhat arched, and the legs are stout and moderately long. The hair is brownish-gray, with dark markings on the legs and a dark stripe down the back; there is a large white spot on the neck, just below the chin. In the male the horns are 9 inches in length. Gorals are usually seen in pairs or in small companies of three or four. They are not very wild, and afford good sport to Anglo-Indian sportsmen.

GOR'DIAN (M. Antonius Gordianus) was the name of three Roman emperors.

Marcus Antonius Gordianus, surnamed *Africanus*, born under the reign of the first Antoninus, of one of the most illustrious and wealthy families of Rome, made himself very popular during his quæstorship by the great sums which he spent on games and other amusements for the people. He was successively colleague in the consulship with the emperors Caracalla and Alexander Severus, and eventually became proconsul of Africa in 237. When an insurrection broke out in that province against the Emperor Maximin the insurgents saluted Gordian as emperor. He prayed earnestly to be excused on account of his great age, being then past eighty; but the insurgents threatening to kill him if he refused, he accepted the dignity, naming his son (also a Marcus Antonius Gordianus) as his colleague, and both made their entry into Carthage in the midst of applause. The Roman senate confirmed the election, and declared Maximin and his son enemies to the country. But Capellianus, governor of Mauritania, collected troops in favour of Maximin, and marched against Carthage. The younger Gordian came out to oppose him, but was defeated and killed, whereupon his father strangled himself. Their reign had not lasted two months, yet they were greatly regretted. The younger Gordian was forty-six years of age, was well-informed, and had written several works. The senate elected Balbinus and Maximus Roman joint-emperors in their place.

Marcus Antonius Gordianus, surnamed *Pius*, son and grandson of the elder Gordians, was twelve years of age when he was proclaimed Cæsar. The senate named him colleague of the two new emperors, Maximus and Balbinus; but in the following year (238) a mutiny of the prætorian soldiers took place at Rome, Balbinus and Maximus were murdered, and the boy Gordian was proclaimed sole emperor. His disposition was amiable, but at the beginning of his reign he trusted to a certain Maurus and other freedmen of the palace, who abused his confidence and committed many acts of injustice. Gordian married Furia Sabina Tranquillina, daughter of Misitheus, who disclosed to Gordian the disgraceful conduct of Maurus and his friends. These men were driven from court. From that moment Gordian placed implicit trust in his father-in-law, on whom the senate conferred the title of "Guardian of the Republic." In 242 the Persians, under Sapor, invaded Mesopotamia, and entered Syria. Gordian set out from Rome at the head of a choice army, and drove Sapor back to his own dominions. The senate voted him a triumph, and also a statue to Misitheus. In 244 Gordian advanced into the Persian territory, and defeated Sapor on the banks of the Chaboras; but, while he was preparing to follow him, Philippus, an officer whom he had named general on the death of Misitheus, caused him to be murdered. A monument was raised to him by the soldiers at a place called Zaitha, 20 miles east of the town of Circesium, not far from the left bank of the Euphrates. Gordian was about twenty years old when he was killed.

GORDIAN KNOT, a term applied to anything of an intricate character or of difficult solution. "Cutting the Gordian knot" originated from the story of Gordius, a Phrygian, who though originally a peasant was raised to the throne. It is thus related by the ancient historians: During a sedition the Phrygians consulted the oracle, and were told that all their troubles would cease as soon as they chose for their king the first man they met going to the temple of Jupiter mounted on a chariot. This man was Gordius, who was elected king, and consecrated his chariot in the temple of Jupiter. The knot which fastened the yoke to the beam was tied with so much art, and the strings were twisted in so intricate a manner, that it was impossible to discover where it began or ended. From this circumstance a report was soon spread of the oracle foretelling that the man who could untie it should possess the empire of Asia. Alexander the Great on his capture of Gordium, being anxious to inspire his soldiers with courage, and make the people believe that he was destined to conquer Asia, attempted to untie this knot; but failing in his object, he exclaimed, as Quintus Curtius informs us—"It is no matter which way it is loosed," and at once cut the knot with his sword; and by that means, says the historian, either eluded or fulfilled the oracle: "Sortem oraculi vel elusit, vel implevit."

GOR'DIUS is a genus of nematode worms (Nematoidea). The most familiar species is *Gordius aquaticus*, a fresh-water form, popularly known as the hair-worm, from the belief, formerly almost universal, and even yet held by a few, that a black horse hair, if kept long enough under running water, would become alive in this shape. The folly of this imagination need not be pointed out here. These hair-worms in their larval state are internal parasites in the bodies of the larvæ of gnats and various aquatic insects; here they remain inclosed in a cyst, but moving freely within it till the larva is devoured by a fish. The parasite is now set free, and soon encysts itself again in the mucous membrane of the fish's intestine. In the spring the parasite becomes free and passes out to the exterior, where it becomes sexually mature. In passing from the larval to the mature condition great degeneration takes place. The alimentary canal and even the mouth disappears. The adult is very long and slender, often a foot in length. Many of them are often found twisted together in a knot; from this circumstance arises the generic name Gordius. See Gordian Knot.

GORDON, LORD GEORGE, the prime mover in the Gordon riots, was born on the 19th of September, 1751. On the passing of a bill to relieve Roman Catholics from certain penalties and disabilities, he was elected president of a society established to procure the repeal of the Act. A mob of about 100,000 persons, headed by Lord George, proceeded to the House of Commons to protest against the bill, and riots ensued which lasted several days. Catholic chapels, the mansion of the lord chief-justice, Newgate jail, and many private houses were destroyed. The leader was arrested and tried for high treason, but acquitted. His subsequent conduct was equally rash and foolish. Ultimately he was convicted of publishing a libel on the Queen of France and the French ambassador, and died during his imprisonment in Newgate in 1793.

GORDON, MAJOR-GENERAL CHARLES, C.B., R.E., son of Lieutenant-general Henry Gordon, R.A., was born in 1833, and educated first at Taunton and then at the Royal Military Academy, Woolwich. He entered the Royal Engineers as lieutenant in 1852, and served in the Crimea, where he was wounded. At the close of the war he was employed in the delimitation of the Russo-Turkish boundary, and subsequently took part in the expedition against Pekin. By 1863 he had entered the service of the Emperor of China, and took the field as commander to combat the Tai-ping rebels, who had gained possession of the rich districts of the Yang-tse valley and were rapidly reducing them to wastes. Within two years he had crushed the rebellion, and by his energy, contempt of personal danger, power over his men, and almost invariable success, he inspired his enemies with a superstitious dread which did much to achieve his victories. He rose to the highest rank in the Chinese army, but when recalled by the British government he quitted China without accepting the smallest pecuniary reward. In February, 1864, he was promoted lieutenant-colonel and received the order of Companion of the Bath. From 1871 to 1873 he was British vice-consul of the Danube delta. But the second great epoch in his career began when he entered the service of the Khedive of Egypt, and in 1877, as Gordon Pasha, assumed the governorship of the Soudan. Here his Chinese career was almost repeated; he had to suppress revolts, crush the slave trade, and establish law, order, and justice in an immense tract of country. His energy, straightforwardness, and perfect justice were new and strange qualities to his subjects, and in Egypt, as in China, he won the love of his inferiors, the fear of his enemies, and the respect of all. Then followed a broken and unsatisfactory period. Resigning his post in 1880 he was successively and for short periods secretary to Lord Ripon, commander of Royal Engineers at Mauritius, where he became major-general, and, finally, an official of the Cape government, a post which he soon resigned.

In 1882 the military rebellion of Arabi Pasha in Egypt, followed by the religious revolt of the Mahdi or false prophet, paralyzed the Egyptian government, which appeared unable to suppress the latter; so Gordon was requested by the British government to go to Egypt and report on the military situation, especially saying how the garrisons could best be withdrawn from the Soudan, and what should be done for the safety of the Europeans at Khartoum. Arrived in Egypt Gordon was at once appointed governor-general of the Soudan, and started for Khartoum with *one* English companion (Colonel Stewart, 11th Hussars) and a few Arabs. He reached it on the 18th February and at once proclaimed, "I come without soldiers, but with God on my side, to redress the evils of the Soudan," and he was received with acclamation by the natives. Once there, however, he and the British government could not agree on a plan by which the garrisons could be withdrawn without leaving anarchy behind. Meanwhile the power of the Mahdi increased, and gradually advancing northwards he at last laid siege to Khartoum. For 317 days Gordon held out, awaiting a British relieving expedition which was advancing up the Nile, and his heroic struggles against the foe without and famine and treachery within form one of the noblest chapters of the history of the English in Egypt. But at last the starved and worn-out garrison succumbed, and Khartoum fell on the 26th January, 1885, when the advanced guard of the relieving expedition was within two days of its destination and actually in communication with Gordon, who could easily have saved himself by abandoning the garrison. During the confusion Gordon was killed, probably by some one who did not know him. Throughout life his actions had been exclusively guided by the strongest religious feelings and sense of duty, and in his death the civilized world felt that it had lost one of the noblest heroes of our day.

GOREE', a small island near the western coast of Africa. It lies along the southern shore of the tongue of land with which Cape Verd projects into the Atlantic, in 14° 39′ N. lat., and 17° 21′ W. lon. The island consists of volcanic rocks, partly covered with sand, with which has been mixed vegetable mould brought from the continent. It belongs to the French, who have erected some fortifications. At the north-east extremity of the island is a roadstead, safe for shipping during eight months of the year. The town has 2500 inhabitants, and covers two-thirds of the island. It is the seat of civil and commercial tribunals, a free port, and the entrepôt for French commerce on the coast of Senegambia. Goree exports gold dust, ivory, wax, &c. It is deficient in water, but is considered healthier than the mainland. Among the natives it is known as *Bir* or *Berr*.

GOR'GIAS, of Leontini, in Sicily, a statesman, sophist, and orator, belongs to the most brilliant period of the literary activity of Greece, and has been immortalized by the dialogue of Plato which bears his name. The most probable date for his birth is 475 B.C. To the eighty-fourth Olympiad is assigned the publication of his philosophical work entitled "Of the Non-being, or of Nature," in which, according to the extracts from it in the pseudo-Aristotelian work, "De Xenophane, Zenone, et Gorgia," and in Sextus Empiricus, he purposes to show, 1st, that absolutely nothing subsists; 2nd, that even if anything subsists, it cannot be known; and 3rd, that even if aught subsists and can be known, it cannot be expressed and communicated to others. Gorgias devoted himself to the practice and teaching of rhetoric, and his professional labours seem to have been attended both with honour and with profit. Both Alcibiades and Æschines were his pupils.

GOR'GONS, in the Greek mythology, were three daughters of Phorkys, a marine god, and his wife Keto. Their names were Medusa, Euryale, and Stheno. They were sometimes described as having great wings, sharped crooked claws, teeth like the tusks of the wild boar, and snakes instead of hair. They were said to have had the power of turning into stone all those who gazed on them. Athena encouraged Perseus in the enterprise of overcoming the Gorgons. She lent him various magic aids, and a shield brilliantly polished, so that he was able to strike off the head of Medusa when sleeping without actually seeing her stony face except by reflection. The goddess claimed the severed head, which she fixed in the centre of her ægis or breastplate.

GORIL'LA (*Troglodytes gorilla*), the largest of the anthropoid apes. It is confined to Western Equatorial Africa, inhabiting the country lying between the Cameroon and Congo rivers. Hanno, a Carthaginian admiral, gives the following account of these apes in his *Periplus:*—"In the bottom of this bay there was an island similar to the one previously described (in his voyage); this contained a lake, and in this lake there was another island inhabited by wild men. The women were most numerous; they

were entirely covered with hair, and our interpreters called them *Gorilloi*. We pursued them, but could not capture the men; they all escaped us by their great activity, as they climbed the rocks and defended themselves by throwing stones at us. We only caught three women, who resisted by biting and scratching their conductors, and we were forced to kill them. We skinned them, and brought back their skins to Carthage." These skins were placed in the temple of Astarte in Carthage, where they remained until the taking of that city in the year 146 B.C., as stated by Pliny, who, however, only mentions two of them, and changes the name of these wild men into *Gorgones*. It is, however, considered by some writers that Hanno's *Gorilloi* were not the man-shaped apes now associated with that name, but were baboons, Hanno's account of these creatures climbing rocks and hurling stones agreeing better with the habits of the latter. It was not until the latter part of the sixteenth century, when the intercourse of Europeans with the west coast of Africa became more extended, that the accounts of travellers began to furnish more reliable information upon these man-like apes, although the earlier of these accounts are mixed up with fabulous narratives obtained from the negroes. Andrew Buttel, an English sailor who was taken prisoner by the Portuguese in 1589, and resided for several years in Angola, mentions "two kinds of monsters" which inhabit the woods of that country; of these the largest, which he says is of gigantic height, is called *pongo*, and the other *engecko* by the natives. The pongo appears to be the gorilla, and the other the chimpanzee. But it was only in 1847 that certain evidence of the occurrence of a second species of African ape was obtained. Dr. Thomas Savage, an American missionary, obtained some skulls and other parts of skeletons of large apes, which appeared to him to differ both from the orang and from the chimpanzee. He also gathered from the natives much information as to the habits and appearance of this dreaded ape. With his aid Professor Owen described this ape as specifically but not generically distinct from the chimpanzee; he placed it therefore in the genus Troglodytes. Our knowledge of the gorilla was increased largely by the traveller Du Chaillu, who saw many of these apes alive and dead, and found out much concerning their habits, but was able to send only some dead specimens to England. Du Chaillu's account of the tremendous strength and ferocity of the gorilla has not been borne out by subsequent travellers.

The gorilla is about 5 feet 4 inches in height when fully stretched, but appears shorter owing to its usual habit of walking on all fours. A position more or less upright may be assumed for a short time, but, for anatomical reasons, the animal could not balance itself long. When walking it rests on the knuckles of its fore limbs, which are very much longer than the hinder pair; when the body is quite erect the arms reach to the knees. The hand is very large, but the fingers are short and thick. The digits of both pairs of extremities are united together much further than in the chimpanzee, whose hands nearly resemble those of the human species; in the new species, on the contrary, the fingers of the hands are united nearly as far as the ends of the first phalanges, while in the feet the union even goes beyond these, leaving only four little stumpy toes free. The thumb of the hands is comparatively small; but that of the foot is of enormous size and power, and the whole foot forms a grasping apparatus of the most tremendous character. From the callous marks upon the knuckles it is evident that the gorilla, when on the ground, walks upon all fours, and that he does not apply the whole lower surface of the foot to the ground. The foot of the gorilla is turned inward in walking. There are thirteen pairs of ribs. The skull is provided, especially in the male, with great crests for the attachment of the muscles that move the lower jaw. The teeth resemble, in number and arrangement, those of man. The canines are large and tusk-like; there is a break (*diastema*) in the series of teeth. The palate is long and narrow. The larynx is provided with large air-sacs. The belly is very large and prominent. The hair of the gorilla is brownish-black, turning gray with age. The chest is bare in the adult, and very scantily clothed in the young animals. The palms of the hands and the soles of the feet are bare and intensely black. The skin is everywhere black. The head and neck are thickly covered with brownish grizzled hair of moderate length.

The food of the gorilla consists exclusively of vegetables. Gorillas are polygamous. The African traveller Winwood Reade asserts that the ferocity of the gorilla is no greater than that of any other vegetable-feeding wild animal, and that he will not voluntarily attack man. The native hunters considered that the leopard was more dangerous to encounter.

Young gorillas have been occasionally kept in confinement in Europe, but with small success, the little animals dying very quickly. A young gorilla was obtained in the winter of 1883 by the Natural History Museum at Paris. In disposition this animal, which was about three years old, differed greatly from the orang-outan or the chimpanzee, being very savage, morose, and brutal. He was very inactive, usually crouching sullenly in a corner of his cage. His intelligence was feebly developed. After spending some six or eight months in captivity he died.

GORSE. See FURZE.

GOR'TSCHAKOFF, PRINCE ALEXANDER, so long the guide of the foreign policy of Russia, was born on the 16th of June, 1798. In 1824 he was appointed secretary to the Russian embassy in London, and devoted much of his time to the study of foreign languages. In 1830 he became chargé d'affaires at Florence, and two years later he joined the Russian legation at Vienna, where the death of the ambassador suddenly forced him into considerable prominence. In 1841 he was sent as ambassador-extraordinary to Stuttgart, and by acting for ten years as the young grand-duchess's guide, counsellor, and friend in the little court world of Stuttgart, he established the friendly relations with the imperial family which were subsequently of such great service to him. In 1850 the sphere of his activity was extended by his appointment as minister-plenipotentiary to the German Bund, in addition to his previous functions. In 1854 he was nominated by the Czar Nicholas to the post of ambassador at Vienna. After the Crimean War he succeeded Count Nesselrode in the ministry of foreign affairs, an office which he held continuously for more than twenty years.

At the time of the suppression of the Polish rebellion in 1860–63, he gained great popularity in Russia by his haughty repudiation of the right of foreign nations to interfere, and in July, 1863, he received the appointment of chancellor of the empire for foreign affairs. During the war between France and Germany in 1870–71 Prince Gortschakoff maintained the prudent and reserved policy which he had carried out for many years. In November, 1870, he proposed the meeting of a conference in London to revise the treaty of 1856, so far as it concerned the rights of Russia in the Black Sea. Lord Granville assented, and on the 13th of May, 1871, the guarantees required by the treaty were suppressed. The alterations effected by the treaty of Berlin, in the terms exacted from Turkey by the treaty of San Stefano, practically brought the prince's public career to a close, though he retained his position at the foreign office until a year before his death, which took place on 11th March, 1882.

GOS'HAWK (Astur) is a genus of birds of prey (FALCONIDÆ) belonging to the subfamily Accipitrinæ (HAWKS). This genus is characterized by a short beak, bent downwards from the base and convex above, with somewhat

oval nostrils. The legs are long and the toes short and stout, with sharp talons. The wings are short. Numerous species of this genus are diffused over all parts of the world but Europe, which only contains one, ***Astur palumbarius*** (the goshawk), so highly prized by the falconers of old, and famous for its flights at cranes, geese, pheasants, and partridges. A full-grown female measures 24 inches in length; the male is about a fourth smaller. It flies low, and pursues its prey in a line after it, or in the manner called "raking" by falconers. If the game takes refuge it will sit patiently on a tree or stone till it moves, or till some other prey is accessible. It preys on hares, rabbits, pigeons, pheasants, grouse, and partridges. The female was generally flown by falconers at fur, and the male at feather; but the female was also trained to take the largest winged game, the male being principally flown at partridges. The nest of the bird is usually built on a high tree in the outskirts of the forest, and the same nest frequently serves for several years in succession, being added to from year to year; it is rarely found in the interior, except in those parts which are open and free from timber. The eggs are three or four, frequently hatched in the middle of May. They are of a pale bluish-white colour, without any spots or streaks.

Goshawk (*Astur palumbarius*).

The Common Goshawk is found tolerably abundantly in many parts of Europe. In Britain it is now very rare. It also occurs in India and many parts of Asia. This species is the largest of the "short-winged" hawks of the falconer, the full grown female measuring about 2 feet in length, while the males are often one-third less. The plumage of the upper parts is brown and that of the lower surface nearly white—spotted, barred, and lined with black; the tail feathers are barred transversely with light and dark brown; the beak is horn-colour or bluish-black, the cere and feet yellow, and the claws black. The young birds differ somewhat in their plumage, the under surface being reddish streaked longitudinally with dark brown. In North America the place of the common goshawk is taken by a very similar species, *Astur atricapillus*. ***Astur novæ-hollandiæ***, found principally in the colony of New South Wales, is remarkable for the pure white colour of most of the specimens, only a few being occasionally met with in which the back is gray and the feathers of the chest marked with brownish transverse lines. The gray birds are peculiar to New South Wales, but the white specimens not only occur in that colony, but also in Van Diemen's Land. While some naturalists regard this as a case of dimorphism, others consider these two forms to be distinct species.

The Australian Goshawk (*Astur approximans*) is a far more abundant species than the preceding, although occurring principally in the same range of country. The general colour of its plumage is brown, with numerous narrow transverse grayish bands on the lower surface. It is an active, bold, powerful, and sanguinary species, destroying great quantities of small birds, quadrupeds, and reptiles. Its nest—which is of large size, built with sticks, and lined with leaves of the gum-tree—is usually placed among the boughs of a large swamp oak (***Casuarina equisetifolia***), and commonly contains three eggs of a bluish-white colour, covered with patches of brownish-buff.

GO'SHEN, that part of Egypt which was assigned to the people of Israel while dwelling in that country. It is probable that Goshen was in the easternmost part of Lower Egypt, around the town of Phacusa. The site of this city is 20 miles south of San, the site of Tanis.

GOS'LAR, one of the oldest towns of Germany, was formerly a frequent seat of the German Diets, and a residence of the emperor. It is 27 miles south-east of Hanover. The population is 11,000. The town has manufactures of vitriol, shot, hardwares, carpets, and leather, and many of the inhabitants are employed in distilling and brewing. It is inclosed by walls. The principal buildings are the churches and conventual edifices, an hospital, and a college. Its greatest curiosity, a cathedral finished in 1050, was almost wholly pulled down in 1820; little now remains of it except a small chapel, containing an ancient Saxon altar and some other curiosities.

GOSPEL. The name gospel, in Old English *godspell* (*spell*, discourse or news about *God*, *i.e.* Christ), is used as the equivalent of the Greek *evangelion* (εὐαγγέλιον), which signifies *good news*. It is not known at what period this term was first applied to the narratives of the life and words of Jesus, but it was in common use during the third century, and according to some scholars it is to be found in writings which date from a period at least half a century earlier. The four Gospels were pronounced canonical and authoritative by the councils held towards the close of the fourth century, and they have ever since been received in this sense by the whole Christian church. They profess, however, to be written during the apostolic period, and it will be necessary to consider the evidence that exists in favour of this claim in addition to the fact of their being accepted by the early church. This is found chiefly in the writings of the fathers, portions of which, extending from the fourth century back to the times of the apostles, are extant, and which display an acquaintance with the Gospels and a frequent reference to them. Thus in the fourth century Chrysostom wrote commentaries on the whole of the New Testament, and the works of Gregory of Nyssa, Jerome, and Augustine also date from this period. More than a century earlier we find Irenæus, the bishop of Lyons, where the first Christian church in Gaul was founded, writing a work against gnosticism, in which he observes that "so well established are our Gospels that even teachers of error themselves bear testimony to them; even they rest their objections on the foundation of the Gospels." In his extant works nearly 400 references to the words of the Gospels have been counted, over eighty of which are taken from the fourth, attributed to St. John. Tertullian also, a converted pagan who lived at Carthage about the end of the second century, and became a powerful apologist for Christianity, refers in his works to the *four* Gospels; and while he quotes freely from them all, he discriminates between those written by the apostles and those written by their disciples, giving the highest place to the first and fourth. Half a century earlier, or about the middle of the second century, two harmonies of the four Gospels were written, one by Theophilus, bishop of Antioch in Syria, and the other by Tatian, a disciple of Justin Martyr. The Muratorian catalogue of the sacred books, which is supposed to date from the same period, gives the names of Luke and John—the commencement of the list, which should have the names of Matthew and Mark, being destroyed. This is almost the earliest evidence that can be found giving the names of the four books; but Justin Martyr, writing in defence of Christianity, probably between 139 and 147, refers to certain extant written documents, which he designates "the memoirs written by the apostles and by those who attached themselves unto them." This expression is interpreted by most modern scholars as

containing an undoubted reference to the Gospels; beyond this in his writings there are numerous quotations from all the Synoptical Gospels, and several sentences which bear a great resemblance to some of the passages peculiar to the fourth Gospel. Quotations from the Gospels are also to be found in the works of Papias, Ignatius, Polycarp, and Barnabas, which takes the evidence back to the apostolic period itself. There are also other lines of evidence which show the same result, such as the existence of translations made into other languages at a very early period in the history of the church; the use made of the New Testament, and especially the Gospels, by the various heretical and gnostic sects which arose during the second and third centuries; and lastly, the use made of the Gospels by those who wrote against Christianity.

In considering, in the next place, the authorship, structure, and design of the Gospels, it will be convenient to separate the first three, which from their general agreement in narrative and language are termed the Synoptical Gospels, and the fourth, which is admitted by all critics to be of a later date and different design to the others.

The shortest and probably the earliest is the Gospel according to St. Mark, who is identified by the unanimous testimony of the fathers with John Mark, the cousin of Barnabas, who is mentioned in the Acts and the Epistles of Paul and Peter. There is a unanimous tradition also to the effect that he was the disciple and interpreter of Peter, whose discourses he combined and reported in the Gospel written by him. This tradition is supported by internal evidence also, for scarcely a work of Christ is narrated at which Peter was not present, and most of the incidents are recorded after the manner of one who was an eye-witness. This Gospel was written in Greek, but the writer displays only an imperfect knowledge of the language, using many terms which were rejected as harsh and uncouth by the educated Greeks, and several which are expressly forbidden by the Greek grammarians. It was designed for the use of the Gentile members of the church, and gives numerous explanations of Jewish topography and of manners and customs. The design of the writer seems to be to present chiefly the humanity of Jesus, and he brings forward the *acts* rather than the words of the Saviour in his history. His style is graphic and forcible, places and surroundings being described with some minuteness, and a similar care being displayed as to persons and numbers. The story of the life of Jesus begins with the ministry of John, and there is no reference to his genealogy, miraculous birth, or early life, while it ends with the account of the crucifixion and the vision of the "young man" who announced the fact of the resurrection to the women. The closing verses of Mark (xvi. 9–20) are omitted in the two oldest Greek MSS. as well as by some other authorities, and hence are marked as doubtful by the revisers of 1881.

The next in point of time is the Gospel according to St. Matthew, who was a native of Galilee, and before his call to the apostleship had held the office of receiver of customs under the Roman government. By Mark and Luke he is called Levi, but he speaks of himself as Matthew the publican (Mat. x. 3). The opening chapters of his Gospel give a brief notice of the infancy and childhood of Jesus, and an account of the circumstances attendant upon his entrance on his public ministry. He then exhibits Jesus as a public teacher, a worker of miracles, a teacher by parables, gives an account of his public life, in which his teachings and miracles are recorded in chronological order, and closes his history with a record of the sufferings, death, and resurrection of the Lord. The design of Matthew is evidently to exhibit to his countrymen Jesus as the promised Messiah, in whom was fulfilled "that which was spoken by the prophets." He gives no explanations of topography or customs, but supposes his readers to possess the necessary aquaintance with them. He also narrates at length the refutations of the tenets of the various Jewish sects, traces the genealogy of Jesus through Joseph to Abraham, and refers eight times to Jesus as the son of David. There is a tradition, which is almost unanimously supported by the fathers, that Matthew not only wrote for the Jews, but that he wrote in Hebrew (*i.e.* the vernacular Aramaic). No certain trace exists of any such original Hebrew version, though a gospel written in Hebrew characters, and ascribed to Matthew, seems to have been known at an early period. [See GOSPEL ACCORDING TO THE HEBREWS.] The Greek version certainly enjoyed high authority from the earliest times, and it has been suggested that possibly Matthew wrote in both languages. From the internal evidence afforded by the book it is plain that this Gospel was written before the destruction of Jerusalem, but beyond this it is not easy to assign the date of its composition.

Latest of the three comes the Gospel according to St. Luke, who was also the author of the Acts of the Apostles and the friend and companion of Paul, who refers to him as "the beloved physician." The design of this Gospel is stated in the first four verses, in which it is dedicated to a certain Theophilus, either some person of honour and station, or a name designed to include all such as were beloved by God. Luke is generally regarded as being a person of scholarly attainments, and the style and language of his Gospel is more classical than that of his predecessors. His biography of Jesus is supposed also to preserve the chronological order of the main facts with greater care than those of the other evangelists, and he gives numerous and important incidents omitted by them. Designed for Gentile converts it contains explanations which would be unnecessary to Jews, and its aim appears to be to exhibit Christ as the Saviour of all men, thus reflecting the teaching of Paul in its catholicity and fulness. Its date cannot be fixed with any degree of certainty, but it seems to have been written after the fall of Jerusalem, possibly about the year 80. It is but just to state that by what is called the "advanced" school of biblical criticism later dates are advocated as probable for these Gospels. The views here given are those of orthodox theologians.

In reference to these three Synoptical Gospels, it has been fully established that in such portions of the story as are common to them all they use the same words and phrases in narration to an extent unknown among independent writers elsewhere, and sufficient to prove (1) either that they have borrowed from or used each other's writings, or (2) have each drawn materials from some common source. The first of these ideas was that which formerly prevailed among biblical critics, who succeeded in proving to their own satisfaction that each of the three Gospels was the first to be used in this way, but the second opinion is that which is now generally accepted among competent scholars. The extent of the unity which prevails has been illustrated in the following manner: if the three Gospels be divided into sections, there are forty-three which are common to all the evangelists. This does not imply literal agreement, but that there is a substantial coincidence as to fact and utterance. Besides these there are fourteen sections common to Matthew and Luke, twelve to Matthew and Mark, five to Mark and Luke, while Luke has nine sections peculiar to himself, and Matthew five. There are only twenty-four verses in Mark which contain any important fact omitted by the other evangelists, but these contain two miracles, viz. the healing of a deaf and dumb man, and the restoring of sight to one who was blind (see chapters vii., viii.) The facts common to all are generally referred to as the triple tradition, those common to any two evangelists being termed the double traditions of the respective writers, *i.e.* of Matthew and Luke, Matthew and Mark, &c. Concerning the triple tradition it has been

found that it begins with the proclamation of John the Baptist concerning the advent of a prophet greater than himself; it includes eleven of the miracles, but only eight of the parables; it omits several of the more lengthy of the discourses of Jesus, but gives others in detail; it does not include the Lord's Prayer, and farther it omits the genealogies, the miraculous incarnation, the early life of Jesus, and if the last verses of Mark be rejected, the accounts of his appearances after the resurrection. The fact of the resurrection, which formed the foundation of apostolic teaching, however, is affirmed by *all* the Gospels, and though it is generally believed that the closing verses of Mark have been added by a later editor, it is also supposed that they were inserted to supply some missing portion of the original work, which is hardly likely to have terminated with the eighth verse of the closing chapter. Although there is this great general agreement in the narratives of the synoptics, there are also certain apparent discrepancies which have called forth much ingenuity on the part of commentators. Among these may be mentioned the genealogies of Matthew and Luke, which appear not only to differ from each other, but also from that of a portion of the line given in 1 Chron. iii. 19–24; the healing of the two demoniacs mentioned by Matt. viii. 28, whereas Mark and Luke speak only of one; the two blind men near Jericho, also mentioned by Matthew, but where again the other two Gospels speak of but one; the healing of the centurion's servant, recorded by Matthew and Luke, but with considerable variation in the circumstances; and the accounts of the appearances of Jesus to his disciples after his resurrection, which present more difficulty in the way of harmony than perhaps any other portion of the sacred narrative. There have been numerous attempts on the part of biblical scholars to explain and harmonize these and other apparent discrepancies in the Gospels, and most modern commentaries enumerate the principal solutions that have been presented.

Concerning the source from whence the triple and double traditions were derived there has been and still is great difference of opinion. The principal theories, however, are such as suppose either the existence of one common document from which all the compilers drew, or that there were several documents which were used in this way, or that the Gospels were derived from the oral teaching of the apostles. The theory which supposes one evangelist to have copied from another has already been referred to. Eichhorn supposed that five common documents were drawn upon by the evangelists, and Bishop Marsh increased the number to eight; but neither of these suggestions has obtained much acceptance among scholars. Among English critics the theory obtains most favour which bases the Gospels on the oral teaching of the apostles, without, however, excluding the use of some written documents, such as are referred to by Luke in his preface as being in existence.

Turning now to the consideration of the fourth Gospel, it may be observed that there is a general consensus of testimony among the earliest writers that this was written towards the close of the first century, and after the other Gospels had obtained recognition. The readers of this Gospel are evidently supposed to be already acquainted with the principal events in the life of Jesus, as most of the incidents recorded in the Synoptical Gospels are passed over, while most of the parables, the sermon on the mount, the predictions of the fall of Jerusalem, and all the miracles save eight are omitted. Nearly two-thirds of this Gospel are taken up with additional matter, and one-third is devoted to an account of the sayings and doings of the Lord during the twenty-four hours preceding his crucifixion. One of the miracles recorded, the feeding of the five thousand, is given by the other three evangelists, but four at least of the miracles are peculiar to John. In this Gospel also we find that Jesus is spoken of as attending three passovers at least (some make the number four), and most of it is taken up with the words and works of Jesus in Judea, while the Galilean history is chiefly given by the other evangelists, and one passover only is referred to.

The evidence for the existence of this Gospel during the latter part of the second century has already been referred to in this article, but the evidence of its existence at an earlier period is not so conclusive as that of the Synoptical Gospels. The reference to Christ as the Word (Gr. *logos*) in the first chapter, and the subsequent development of this conception throughout the Gospel, the different character of the reported discourses of Christ, and the additional details it contains concerning the appearances of the Lord after his resurrection, have led many critics to assign its composition to a period later than that of the apostle John; but, on the other hand, its genuineness and authenticity are defended by some of the foremost modern scholars. The genuineness of a few of the verses given in the Authorized Version of this Gospel have been greatly called in question, and one (chap. v. 4) is omitted by the revisers of 1881, while another portion (chap. vii. 53 to chap. viii. 11) is marked as doubtful. That the latter contains a genuine tradition of Jesus, however, is generally admitted.

Though it is universally recognized by scholars that much work remains to be done before the critical questions raised concerning the Gospels can be finally settled, the literature on the subject is already very extensive and voluminous. One of the best English works is the "Introduction to the Gospels," by Canon Westcott (fifth edition, 1875). For the controversy as to the authorship of the fourth Gospel, among the best English works are the "Authorship and Historical Character of the Fourth Gospel," by Dr. Sanday (1872), and the Introduction of Canon Westcott given in the "Speaker's Commentary" (1879). For an explanation of the modern theory as to the construction and order of the first three Gospels see "The Common Tradition of the Synoptic Gospels," by E. A. Abbott, D.D., and W. G. Rushbrooke, M.A. (London, 1884).

Gospels, Apocryphal. These curious, and for the most part puerile, productions have survived the vicissitudes of time in a remarkable manner. Even to this day they are much read, though of course curiosity, rather than the hope of any solid benefit, is the motive impelling men to make their acquaintance. Fathers of the church like Jerome call them heretical, or with Epiphanius roundly attribute them to the devil himself; popes like Damasus or Gelasius thunder anathemas at them, and councils of the church abjure them; yet they have been edited again and again, and Tischendorf himself honoured them with what probably will prove to be their final form in an exhaustive collective edition ("Evangelia Apocrypha," &c., Leipzig, 1853). The true reason of their vitality is the perennial and absorbing interest in anything connected with the personality of Jesus Christ. Every man feels in taking up this ancient tissue of absurdities that amidst the rubbish he may perhaps detect some glimmer of truth to add to our record of the Master. Unhappily his search will prove in vain, but he may still discover materials of interest in other though far inferior spheres.

There are some sixty of these Gospels, but only eight of them are in a fairly perfect condition and of relatively principal importance. These are—1, The "Protevangelium of James" (Greek); 2, the "Gospel of Thomas" (Greek), in two rather differing versions; 3, the "Acts of Pilate," also in two forms (Greek); 4, the "Descent of Christ into Hell" (Greek); 5, the "History of Joseph," the husband of Mary, not the Patriarch (Latin, from a lost Arabic original); 6, the "Gospel of the Infancy" of Christ (also Latin, from a lost Arabic original); 7, the "Pseudo Matthew," sometimes called the "Latin Gospel of the Infancy"

(Latin); and 8, the "Gospel of the Nativity of Mary" (Latin).

These supposed records would account for fifty years of time, the "Protevangelium" and the "Nativity of Mary" dealing with the parentage of Mary and her marriage to Joseph, the Latin "Infancy" running to the eighth year of the childhood of Jesus, and the Arabic "Infancy" to his twelfth year. The "Gospel of Thomas" begins with his third year, and runs on to his presentation in the temple. The "History of Joseph" carries us on to the eighteenth or nineteenth year of Jesus, giving an account of Joseph's death and burial. The Canonical Gospels now continue the tale, and the Apocryphal Gospels take it up again at the trial of Jesus in the "Acts of Pilate," and conclude with the very remarkable "Descent into Hell."

The passages in St. Luke alluding to certain Gospels of his day which he thought not entirely to be depended upon may refer to such writings as the GOSPEL ACCORDING TO THE HEBREWS, but all idea of his referring to these Apocryphal Gospels must be at once dismissed. The earliest of them dates from the second century. It was now evident that Christ's second coming, so ardently expected, was not at all events to be immediately hoped for; and men regretted that the slight sketches of the apostles were all that they had to depend upon for their knowledge of their Master save oral tradition. What wonder then if legends were enlarged somewhat to fill up the places left blank by the evangelists? One such religious romance, the "Acts of Paul and Thecla," written at this time, was absolutely traced to its author, a priest of Asia, who avowed his motive to be pure respect for Paul and not intended deceit: this is recorded by Tertullian. It is in this way, probably, that we get the narrative of Mary's miraculous birth from old parents and of her secluded girlhood. Such things may have foundation, but they are so mixed up with manifest "pious frauds" that it seems strange that they should be credited on this authority.

From the "Protevangel" we get the traditions commonly received (so eager are men naturally to add to their knowledge on these matters, on grounds however slender) of Mary's mother Anna devoting her child to God, of her marriage at fourteen to Joseph, of the character of this marriage (that Joseph was to be "as her guardian"), of the fact that the brothers and sisters of Jesus were children of Joseph by a first wife, of Joseph being an aged man at the time of his marriage, of the animals worshipping Jesus in the manger ("Nativity of Mary"), of the light that shone upon him miraculously there—and not one of these things is to be found recorded in the Canonical Gospels or anywhere else than in these Apocryphal Gospels.

Of all these curious documents the "Protevangelium of James" (a Jew of that name) is at once the most dignified, the most interesting, the most probable, and by far the most valuable. It narrates the sad contemplation by Anna of the fertility of the sparrows in her garden, while she, though blest with a pious husband, is denied offspring. An angel announces to her that this reproach shall be removed. Joachim returns from a long fast in the wilderness, is pronounced sinless by the priest, and in due time Mary is born. She is a wonderful child, walks at six months old, is presented to the priests at twelve months, and is solemnly dedicated to the Lord at three years old, when "she danced with her feet and all the house of Israel loved her." The priests bring her up "like a dove," and she receives her food from an angel. The subject of Raphael's famous "Sposalizio" follows. When Mary is twelve the high priest Zacharias is miraculously ordered to marry her to a widower to be pointed out by a sign. All the chosen ones appear before him with rods, which they hand to the priest for blessing. Joseph is the last to do so, and as he takes it back a dove flies out of it and hovers round his head. He takes Mary to his home, where she works at the great veil of purple for the temple. The girl having been delivered to Joseph as a sacred charge her condition after the annunciation is made a grave reproach to both herself and to Joseph for his negligence in watching over her; and only after a severe examination and a curious ordeal of proof are they held blameless. Circumstances are added to the gospel narrative of the nativity. Mary rests in a cave; and while Joseph is searching for a midwife he observes that all nature pauses in suspense, birds hover motionless in the air, workpeople stand transfixed round their tables, kids touch water and drink not, &c. The cave is filled with light, and Joseph having found a certain Salome, Mary is happily delivered. Salome satisfies herself that Mary remains a virgin, but her hand withers for her unbelief until she takes the babe in her arms, when it is restored.

The "Gospel of Thomas" contains the celebrated fables of Jesus, when five years old, making twelve sparrows out of clay, and bidding them fly, whereupon to the amazement of all they at once take wing; and of his stretching to the proper size a part of a bed which Joseph was making and had by accident cut too short. This is sufficient to show the triviality of the production. Many of the miracles are also very cruel, quite opposed to the loving nature of Jesus.

The "Acts of Pilate," if we could only thoroughly place confidence in it, relates the facts of the trial with great force and circumstantiality; and it is from this that the usual amplifications of the canonical narrative are taken. If the manifestly fabulous parts are cut away the remainder is of value, and probably has some basis.

The "Descent into Hell" is a most extraordinary narrative of two sons of Simeon, Charinus and Lenthius, who rose from the dead at the crucifixion, and again quietly took up their usual residence in their own city, but living in a very retired way and constantly engaged in prayer. These men are brought forward by Joseph of Arimathæa, to convince Annas and Caiaphas the high priests, and describe their resurrection. The news of the great deliverance arrives and the dead are exulting, Adam not the least among them, Satan and his angels being correspondingly depressed. At the voice of thunder, "Lift up your heads, O ye gates! and be ye lift up, ye everlasting doors!" the Lord enters, like to a man, and floods with light the abodes of darkness, signs them all with the cross, and taking Adam by the hand leads him and the others to Paradise. The scene is described with great power, the reproach of Hades (Hell personified) to Satan being especially notable. The two men, after witnessing the accounts of their narrative as correct, leave the assembly and are no more seen.

These sketches are perhaps sufficient to indicate the character of the Apocryphal Gospels. That character, it is observed, is very various; the "Protevangel" and the "Acts of Pilate" impressing us somewhat favourably, the "Descent" moving us with its striking power, the "History of Joseph" with its simple pathos in the account of the end of a good man and the grief of a tender son. (Jesus ordains that "no smell of death shall pass over him, no worm touch him, no limb shall be broken, no hair fall, intact and incorrupt shall he remain to the Millennial Feast.") The rest, if one is to be frank, rather revolt the student by their blasphemous folly. Nevertheless the curious and scholarly reader will probably be repaid for the trouble of consulting them.

GOSPEL ACCORDING TO THE HEBREWS. "Forasmuch as many have taken in hand to set forth in order a declaration of those things which are most surely believed among us, it seemed good to me also to write unto thee, in order, most excellent Theophilus, that thou mightest know the certainty of those things wherein thou hast been instructed"—thus begins St. Luke in his Gospel, gently hinting that many apocryphal or less warrantable accounts

were in existence calling for the need of those who, like himself, believed they had the flawless tradition, the "perfect understanding of all things from the very first," to declare their witness in clear terms. The accounts he refers to are not the so-called Apocryphal Gospels which are described above, documents of the second century or later, and certainly not then in existence. But a very strong case is made out by E. B. Nicholson in his "Gospel according to the Hebrews" (1879) in favour of the long-known fragments of this lost Gospel being anterior to St. Luke, perhaps to St. Matthew. Jerome twice translated this Gospel (which was in Aramaic, or Syro-Chaldaic, and written in Hebrew characters), once into Latin and once into Greek, about 390, and regarded it as of great authority, often quoting it. It was, we are told by Eusebius, quoted by Hegesippus in the middle of the second century. It is also referred to by Irenæus, pupil of Polycarp, bishop of Lyons, in 177, when he says the "Ebionites use that Gospel only which is according to Matthew," and this passage, which refers to the Gospel of the Hebrews (for this is known by full proof from Eusebius and many others to have been the Gospel of the Ebionites), also gives the hint of the early belief that it is probably the original "Hebrew" Matthew, whence the New Testament Matthew is a Greek version. There is great reason to believe that the Ebionites corrupted this priceless treasure, and took away its value therefrom in order to suit their particular views. Nevertheless at least a fifth of thirty fragments which remain scattered through the early fathers in quotations are in strict accord with Matthew, and contain things specially his own, not in common with the other Gospels. Clement of Alexandria (died 213) also refers to this "fifth Gospel;" and Origen, twenty years later, quotes that remarkable fragment from it, "My mother the Holy Ghost took me by one of my hairs, and bore me up to the great mountain Tabor." Jerome also says this Gospel was a favourite of Origen's. As to the "mother" of Jesus being the Holy Ghost, Jerome explains, when he quotes the same passage, that the Godhead is of all sexes and no sexes, and he points out that *pneuma* is neuter in Greek, *ruha* feminine in Hebrew, *spiritus* masculine in Latin, and all mean spirit or "ghost" in this sense. Eusebius, who died 340 A.D., also refers to this Gospel as peculiar to the Ebionites, and quotes it as an authentic document. Eusebius was bishop of Cesarea, and possessed a copy; he was a very learned man, and could not have been easily deceived. Clement and Origen both travelled in Palestine. Epiphanius, writing about 375, and Jerome nearly a quarter of a century later, are our two great sources for the preservation of the fragments of the "Gospel to the Hebrews," and the first of these roundly says it was held by most to be an earlier work of Matthew. "They call it," he continues, "*according to the Hebrews*, because, to tell the truth, Matthew alone in the new covenant set both the exposition and preaching of the gospel in Hebrew speech and Hebrew characters." As said above this Gospel was Aramaic (the ordinary tongue of the unlearned Hebrews) in speech and Hebrew in character. Jerome is quite as confident that Matthew was the author of it, the manuscript of which he studied at Cæsarea.

One passage is very remarkable. It is the account of the baptism of Jesus, and runs thus:—"And a voice *came* out of the heaven, saying, Thou art my beloved son, in thee I am well pleased;" and again, "This day have I begotten thee; and straightway a great light shone around the place." This clearly shows that Jesus, according to this fragment, was acknowledged as the Divine Son at his baptism by John, and not before. A fierce fight has therefore raged over it, the orthodox stoutly holding it as an Ebionite or Nazarene corruption. There seems little doubt either of the authenticity or of the authorship of these interesting fragments so diligently collected from many writers of the early centuries. Unfortunately they contain not much that is absolutely new beyond what is noticed above. Still even as corroborative evidence of the ordinary text they are very valuable.

GOS'PORT. See PORTSMOUTH.

GOS'SAMER is the name given to the very fine spider-threads which float in the air or form webs on bushes in fine weather. The word is properly *goose-summer*, and in some parts is called *summer-goose*. The name expresses the time of year when it occurs and its downy appearance. Gossamer is produced by young spiders of various families, apparently simply for the purpose of an aërial excursion. The spider produces in the ordinary way a few threads of silk, then cuts the attachment and allows the wind to carry it whithersoever it lists. Some writers, however, think that the spider emits a viscid fluid from its spinnerets, which becomes threads on exposure to the air, and is thus wafted off by the first breeze. Quarles, Spenser, and other poets considered that gossamer was formed of dew. The name is also extended to denote any light flimsy substance.

GOS'SAN (sometimes spelt *Gosson* or *Gossaun*) is the term used, mostly by Cornish miners, for the altered outcropping portion of a mineral vein or lode. It is composed largely of quartz, hydrated oxide of iron, and other ferriferous minerals. It has a reddish-brown or ochreous colour, hence it is called by the French *Chapeau de fer*, by the German miners *Eiserner hut*, and *Pacos*, *Colorodos*, *Negrillos*, by South American miners. It represents the residue or insoluble portion of a sulphide lode that had been acted upon by atmospheric agencies and undergone oxidation. It is usually in a porous, spongy, or vesicular condition, containing often appreciable quantities of the rarer metals, and minerals not present in the original lode, but secondary products thereof, usually sulphates, carbonates, or oxides.

Gossans occur most usually on lodes of copper, iron, or lead. They vary in depth according to the extent to which atmospheric waters can penetrate; naturally their lower limit is the water level of the district; at this level, between the gossan and the unaltered lode, there is generally a rich deposit of complex minerals, which is called the gossan-lode, containing such minerals as anglesite and CERUSSITE in galena lodes, and MELACONITE, MALACHITE, and AZURITE in copper pyrites lodes.

The formation of the gossan and gossan-lode presents many points of great interest. The same general series of changes takes place in most cases, but owing to peculiarities in the original lode, or some other local circumstance, there may be some slight variation. In its original condition the lode usually consists of silicious matter [see GANGUE] and sulphides of various metals, iron as pyrites or as chalybite generally predominating. Atmospheric water, percolating through these, acts as a powerful oxidizing agent; the sulphides are converted into sulphates, and a series of complex reactions ensue, varying according to the minerals present, the final result of which is that the soluble sulphates are carried off in solution, while the insoluble salts of iron and other metals, together with the silicious matter and precious metals, remain behind in a spongy condition, in which generally a certain amount of shrinkage takes place, which gives the gossan a brecciated structure, especially on the upper side or *hanging wall* of the lode. The gossan-lode is formed from the solution of salts leached out of the superincumbent gossan; it occurs along the plane of reaction between this solution and the original unaltered lode. More basic metals are here redeposited from the solution, forming various salts, according to local circumstances.

GOS'SEC, FRANCIS JOSEPH, a musical composer of considerable originality, was born in Hainault, Belgium, in 1733. He was to a great extent self-taught as a boy, but afterwards left his tending of cows, &c., for the choir

of the cathedral at Antwerp. He went to Paris in 1751, and obtained the post of conductor of the band of the well-known farmer-general La Popelinière, which was then almost exclusively engaged in producing the works of Rameau, an education in itself. He established himself, indeed, as one of the first and soundest musicians of the day. He wrote symphonies before Haydn, and quite founded French instrumental writing. It is to Gossec that the École de Chant, out of which grew the famous Conservatoire, is due. He was as much esteemed in the revolutionary times as under the monarchy; and when a "Hymn to the Supreme Being" was needed for Robespierre's famous caricature of a national religion, it was Gossec who composed it. For the state funeral of Mirabeau at the Panthéon, in 1791, he also composed special music, first introducing the GONG into the orchestra on that occasion. It was Gossec also who introduced the FRENCH HORN into the orchestra in 1757. Both in Germany and in England we have previous special uses of the hunting-horn, but scarcely in the orchestral manner of Gossec. At all events he was the first to use it in France.

Gossec was equally successful as a writer of church-music, of operas, and of purely instrumental music. In each department greater men have superseded him, but in his day he was one of the great authorities in his art. He assisted to found the Conservatoire in 1795, and was one of its first professors. He retired at the age of eighty-two in 1815. He died full of honours at Passy, near Paris, in 1829, within four years of becoming a centenarian. He had worked for Louis XV. and XVI., for the Republic, the Directory, and the Empire, for Louis XVIII. and for Charles X. He was writing in Paris twenty years before Gluck arrived there; he wrote symphonies five years before Haydn's first; he had the pleasure of helping Mozart, and saw his whole career and Beethoven's too, as he outlived Beethoven by two years.

GO'THA, a town of Germany, formerly the capital of the duchy of Saxe-Gotha, which upon the extinction of the direct line of ducal princes in 1825 fell to the Duke of Saxe-Coburg. Gotha is on the river Leina. It is one of the handsomest towns in Saxony, and since the ramparts have been laid out in public walks presents an open cheerful appearance. It has four gates, five public squares, and about twenty principal streets, which are well paved and lighted. The population in 1881 was 26,500.

The principal public building is the ducal palace of Friedenstein, which stands on the summit of a high hill, with a terrace like that of Windsor Castle, and is surrounded by gardens and pleasure-grounds. It contains a library of 150,000 volumes and 6000 MSS., a valuable collection of coins, an oriental museum, a gallery of 1500 paintings, and other treasures. The other buildings of note are—the arsenal, the old and new town-hall, house of assembly of the States, seven churches, and a gymnasium. Gotha is rich in educational institutions, and in asylums for the poor and sick.

A large portion of the inhabitants are dependent on the court, the gymnasium, and the garrison for their subsistence. The rest are engaged in the manufacture of muslins, cottons, porcelain, paper, cloth, linen, thread, yarn, camlets, tobacco, musical and surgical instruments, toys, pewter and japan goods, furniture, gunpowder, excellent saddlery, &c. Near the town is the fine observatory built by Duke Ernest II., on the Seeberg, a hill 1192 feet in height. It was the scene of the labours of Zach. The foundation of Gotha is attributed to William, archbishop of Mainz, in 964.

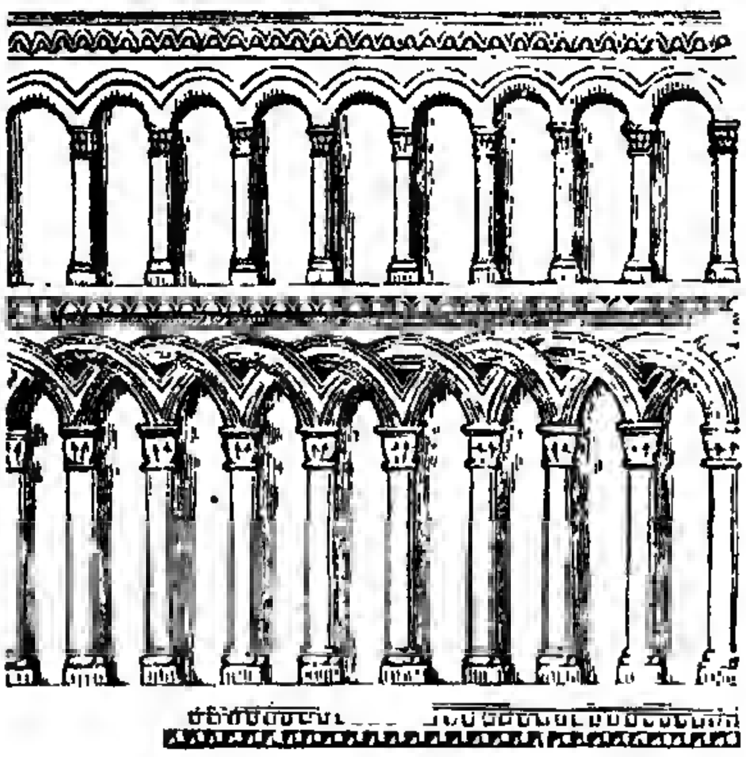
GO'THA, ALMANACH DE, a political and statistical annual published at Gotha, which first appeared in 1764. Previous to 1804 it was issued in German, but when Napoleon became emperor it was changed to French, and is now printed in both tongues. It is a small volume, and contained 296 pages in 1816, 874 pages in 1856, and nearly 1100 in 1885. It is printed in very small type, and contains the calendar, six portraits of living princes, a record of the genealogy and history of the sovereigns and royal families of every civilized country, a list of the births and deaths of distinguished persons since the last edition, a summary of historical events, the boundaries, extent, population, and revenues of states, with the name of every diplomatic representative and attaché, and a list of civil, military, and naval officers. The statistical information relating to every country includes national expenditure and debts, trade and commerce, army and navy, railways, colonies, &c., and is carefully given. No other book contains such a universal register of political facts in so small a compass.

GO'THENBURG or **GOTEBORG,** the chief commercial town in Sweden, situated on the river Göta-elf, about 3 miles from the Cattegat. Opposite the town the river widens to nearly a mile, and forms an excellent harbour, rarely closed by ice. The town is traversed by numerous canals. An excellent system of drainage has been carried out, and there is an ample supply of water. The streets are regular, and intersect one another at right angles. There are numerous churches, of which the most important is the Lutheran cathedral. The other chief buildings are the exchange, the residence house, the old *kronhus*, the artillery barracks, and the theatre. The population is 81,203. The commerce is extensive and very active, especially with England, *via* Hull and London. About 2000 vessels are engaged in its trade with foreign countries, and nearly as many in that with other Swedish harbours. Its exports consist chiefly of iron and steel, grain, oil-cake, timber, tar, and pitch. The imports are coal, coffee, cotton, hides, sugar, tobacco, &c., to the annual value of more than £4,000,000. The town, which is connected by railway with Stockholm, has shipbuilding yards, breweries, sugar refineries, engine and iron works, cotton factories, manufactures of woollens and sail-cloth, &c. At one time the town enjoyed the unenviable notoriety of being probably the most drunken in the world; but by the introduction of "the Gothenburg system"—which gives the right of retailing intoxicating liquors to an "association," that engages to apply whatever profits may result to purposes of general utility, and whose conventions are sanctioned by a resolution of the common council of the town—a considerable improvement is said to have been effected in the character of the town.

Gothenburg is the see of a bishop, the residence of a military governor, and the seat of various courts of justice. It has a chamber of manufactures, and an academy of sciences and literature, incorporated 1775. It was built on its present site by Gustavus Adolphus in 1611.

GOTHIC ARCHITECTURE, more properly called *Pointed Architecture*, refers to that style of architecture in which the pointed arch, applied in various ways, becomes a leading characteristic of the edifice. By some this arch has been derived from an avenue of overarching trees, while others think that they see in interlaced wickerwork the type of Gothic architecture in all its chief forms. These fanciful derivations are as foolish as the name Gothic itself. In an early edition of the *Encyclopædia Britannica* (that of 1797) the author of the architectural article goes so far as to say, "When the empire was entirely overrun by the Goths, the conquerors very naturally introduced their own style of building," in the calmest ignorance that he is antedating the Pointed style by seven centuries; as if one were to attribute the Norman Conquest to William of Orange, instead of to William of Normandy. If, however, the word Gothic be taken to refer to not the followers of Alaric, but the Gothic or Teutonic nations, then the phrase is full of meaning; for the vertical style of architecture, that which delights

in pointed windows, in tall shafts, in high roofs, in soaring spires, is dear to the nations of the north beyond all others. The Gothic style is distinguished as much by these features as by the pointed arch. Nevertheless, as the remarkable change from the semicircular to the pointed arch does perhaps form the most marked alteration from the Norman style of Romanesque, the question remains, whence came this pointed arch? It certainly did not originate in England. This is clear from the few specimens of Anglo-Saxon architecture which remain. (Most of the existing examples of what is called Saxon architecture are in reality Early Norman.) Our earliest architects undoubtedly copied the Italian (Romanesque) round-arched modes of building of the time, though they were far inferior to their originals. From these uncouth and unrefined



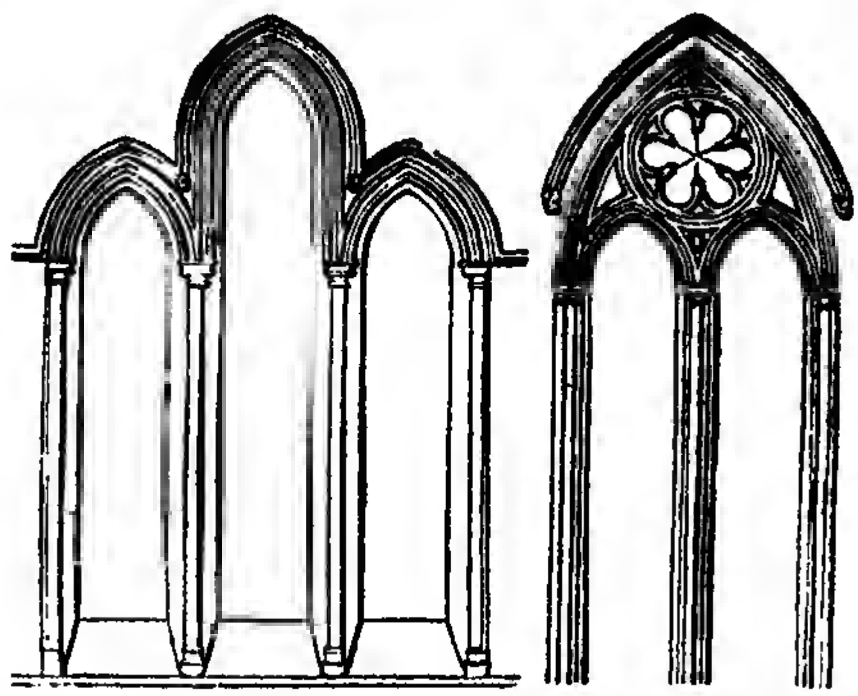
Semicircular Arches, from Lincoln Cathedral.

structures the Normans appear to have rapidly developed the superior and more harmonious style which has been since known by their name, and which in its turn gave place to a still higher development, the Gothic or Pointed style. A little study of Moorish architecture reveals the source of the pointed arch; but what was infertile in Saracen hands became, when introduced by the crusaders returning from the East, of priceless value to the monkish architects of the north. And though Gothic did not spring from an imitation of an alley in a forest, yet there is little doubt that mediæval builders, inspired by the forest-like aisles, seized the hint from nature, and let the shafts branch out into groinings and the window-bars into tracery.

England, France, and Germany respectively claim the invention of the Gothic; but all that can be safely asserted is, that it sprang up about the close of the twelfth century throughout the principal part of Europe. The transition from the Norman to the Gothic was somewhat sudden and abrupt; buildings commenced in the one were completed in the other; and these changes gradually extended even to grave modifications of the designs for the buildings themselves, and not merely to their details or decorations. This is the reason why our larger Gothic buildings offer so many varieties of architecture. The architects were constantly experimenting and innovating. Our cathedrals are, therefore, each of them a kind of visible history of the growth of architecture among us; and we are able to determine with tolerable accuracy the dates of their several parts, and the period of duration of the styles to which they respectively belong.

Different writers have differently classed the chief forms of the Pointed style. Rickman, in the generally received nomenclature, reduces the classes to three: *Early English*, from the end of the reign of Henry II. to the end of that of Edward I., or from 1189 to 1307; *Decorated*, from 1307 to 1377, or a few years later; and *Perpendicular*, from 1377 to the close.

The *Early English* is characterized by the following features:—The arch was at first exceedingly acute, and applied chiefly where small spans were required; but as time went on it became gradually broader, and the aperture to which it was applied increased in width. The windows were lancet-headed and narrow, and consisted first of a single opening, then of two openings combined together, and then of three, where the centre rose higher than the others, as in this example from York Cathedral. And many such lancet windows were grouped to form a grand whole, as in the almost unequalled east window of Ely Cathedral. Next we find the tops of such apertures surmounted by a circular window, and the whole combined within a larger arch, as in the example from Westminster Abbey; where also is illustrated the commence-

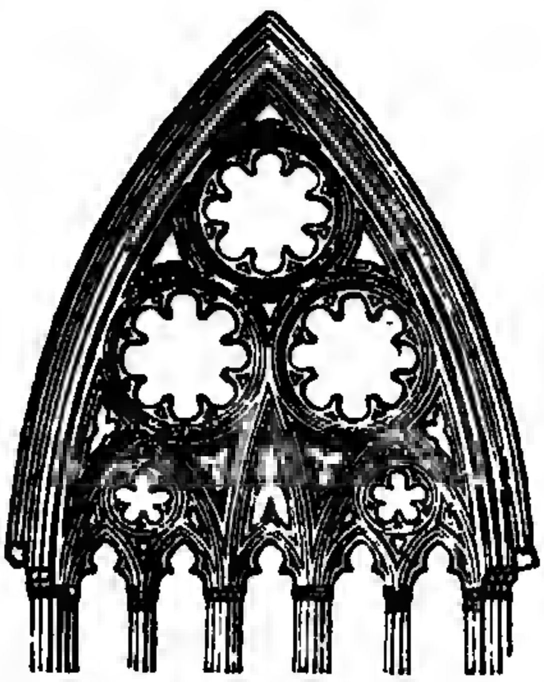


York Cathedral. Westminster Abbey.

ments of that ornamental tracery which became subsequently so rich and characteristic a feature of the Pointed style. The doorways, while similar in character to the windows, varied, however, greatly from them in proportions. While the latter were generally tall, the former were as commonly short; that is to say, the parts beneath the spring of the arch were often long in the one and short in the other, as compared with its breadth in both. The receding sides or splays of the doors retained still the Norman depth, and were enriched with columns. The dripstone or projecting hood-moulding above the doorway rested, in many cases, on carved heads. The pier-arches —so called to distinguish them from arches in the walls— were lancet-shaped, and placed upon piers with shafts, giving somewhat of a clustering effect. The buttresses were narrower, and projected more than in the Norman buildings, and were divided into stages. In mere loveliness of detail Early English is the most exquisite of any form of architecture. Nothing is more beautiful than its detached marble shafts, its deep mouldings, its corbels, bosses, and knots of foliage. The grace and purity of the details of such buildings as the Presbytery of Ely are beyond compare. Other styles give a grander whole: Early English is crowned with its unrivalled detail. The finest English specimen of this style is Salisbury Cathedral. Lincoln and Westminster also present fine examples of it.

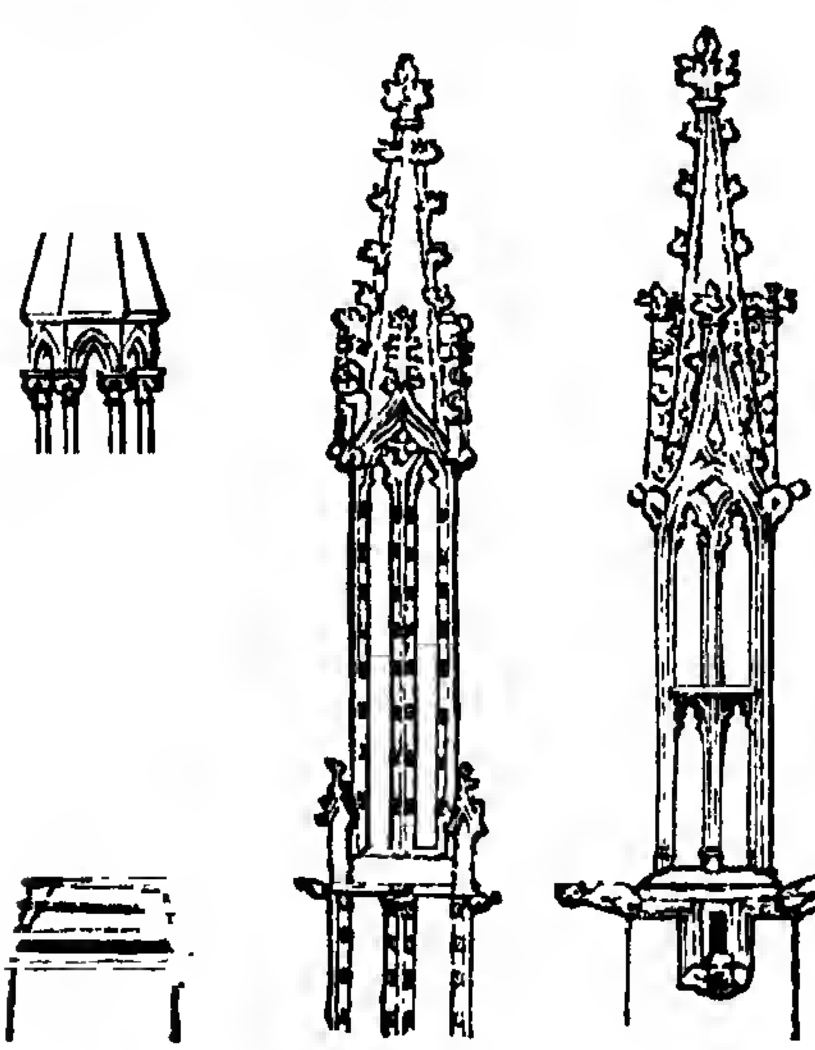
As to the second style, the *Decorated*, this most perfect state of Gothic architecture existed from the middle of the thirteenth to the beginning of the fifteenth century. Its characteristics are, the finely formed arch, included within an equilateral triangle; the clustered column, better

proportioned than heretofore; the mullions of the windows ramifying into rich tracery, in the earlier part of the period composed of geometrical forms, circles, curves, foils, &c. (whence this is by some held as a separate period, the *Geometrical*), and in the later part composed of intersecting and reversed curves of greater freedom, assuming the form of flowers and leaves. Or sometimes the mullions were perpendicular, but broken into compartments by horizontal bars called transoms, the divisions increasing in number as they ascend, until the space within the arch becomes as rich in decoration as the window first described.



York Chapter House (Geometrical).

The example from York Chapter House shows very distinctly and beautifully the progress of the more complex geometrical tracery. As in the windows, so in the splays of doorways and in arch-piers, columns begin to be incorporated with the main pier or splay itself. The hood-mouldings were now often surmounted by other mouldings, forming a kind of gable, called a canopy, enriched with



Wells. Oxford. York.

crockets or leaf-like ornaments on the outer edges. The pediment-heads of buttresses are often similarly decorated.

Pinnacles now increased rapidly in beauty and elaborateness. We give three examples: the first from Wells Cathedral, the second from St. Mary's, Oxford, the third from York Cathedral.

In the groined vaulting of roofs additional variety and richness were produced by the addition of intermediate ribs intersecting each other, so as to produce a kind of tracery consisting of star-like and other figures. Among the finest examples of Decorated Gothic are the choir of Lincoln (1324), the nave of York (completed in 1330), St. Stephen's Chapel, Westminster (begun in the same year), parts of the choir at Lichfield, &c., and, as a finished specimen of general composition, the west front of York.

The third class of the Pointed style, the *Perpendicular*, might, as far as regards the prevalence of particular lines, be more appropriately called, in its latest development, the Horizontal. Thus, while the mullions of windows and the ornamental panellings ran very much in perpendicular lines, the numerous transoms, square-headed labels to doorways, and ornamental string-courses and cornices, furnish abundant illustrations of horizontal lines. Indeed the most striking peculiarity of the style in its later developments is the extreme flattening of the arch, till in some cases the height is less than one-fourth of the span; whereas in the equilateral arch it exceeds that measure. This depressed arch is sometimes called the compound and four-centred, from its being struck from four centres, while the equilateral is struck from two only. The introduction of this arch, also known as the Tudor, marks, in the opinion of many, the period of decline of the Gothic, beginning in the middle of the fifteenth century, when it appears to have been first brought into use. This third class of the Gothic is, in fact, divided into two distinct parts by some critics, to mark respectively the use of the two-centred and of the four-centred arches. The first stage probably represents the highest development of church architecture, except only the contemporary *Flamboyant* of France, most gorgeous of all modes of building. But there are but few buildings either Perpendicular or Flamboyant which restrain their magnificent possibilities within a dignified measure of ornament. The windows already mullioned and transomed became still further enriched by the indentation or embattlement of the transoms. Architects ran riot in decoration. The outline of the doorways became square by inclosing the arch within mouldings forming a label. In many instances characteristics of the earlier and later manifestations of the Florid Gothic were preserved in the same design, as in the well-known doorway of King's College Chapel, Cambridge, where the two-centred arch is preserved in the midst of decorations that belong essentially to the period when the four-centred was chiefly used. The fan-tracery of roofs was now developed into wonderful beauty and splendour, of which the chapels of King's College, Cambridge, of Henry VII. at Westminster, and of St. George's at Windsor, are admirable examples. An interesting feature of this class of the Gothic is its gradual application to domestic purposes, for which it is admirably adapted, both as regards usefulness and beauty. Chimneys were for the first time constructed as a means of decoration as well as for use; and it is worthy of remark that the Tudor is almost the only domestic style in which chimneys aid instead of deteriorating the architectural effect. Bay windows and oriels are both peculiar to the Tudor style; the first appellation referring to projecting windows which rise directly from the ground, the second to those which overhang the lower part of the building.

In this brief sketch of the subject we could not attempt to speak of towers, spires, lanterns, turrets, pinnacles, buttresses, and flying buttresses, of the various forms of gables, and of embattled parapets; of chapels and chantries, shrines and screens, chapter-houses and cloisters, and many other things of the kind, any single one of which would afford matter for a longer article than the whole of the present one. Our silence must extend also to composition and plan, in respect of both of which Pointed architecture offers hardly less variety than it does in its

details and ornaments, the combinations it admits being inexhaustible; whereas in Greek temples we meet with only one or two slight changes of the same idea. In this respect the difference between the two styles is palpable enough, but nowhere does it display itself so strikingly as within. Rarely indeed was the interior of a Greek temple more than a simple oblong apartment, so that a single drawing would suffice to convey a clear idea of it. Of a Gothic cathedral, on the contrary, the interior would, in many cases, require at least fifty drawings from as many different points of view, in order to show it completely, and so that no part should remain undescribed, nor any of its varied effects left to be conjectured from what is shown by sections.

In England and France Gothic architecture ran its magnificent course. Germany imitated them about a century later, and like all imitators was feeble and overloaded in comparison with its originals. The Gothic style also penetrated into Italy, both from Saracenic Sicily as an independent Italian style, and from the northern nations as an imitative style. In Venice it took root in a very remarkable and beautiful variation. Elsewhere it had not much success. Milan Cathedral is the best specimen of an Italian Gothic church. The east fronts of Siena and Orvieto are fine, but they are shams, having no relation to their churches. The finest piece of Gothic work in Italy is, however, Giotto's Campanile at Florence [see the Plate illustrating the article CAMPANILE]; and this, though it is not purely Gothic in all its details, may be pronounced with little fear of contradiction the noblest building in the world. The best manual of English Gothic church architecture, of a moderate size, is that by Bloxam, the eleventh edition of which appeared in 1883.

GOTHIC LANGUAGE. The Gothic language or languages is or are a branch of the Teutonic family. The *Altgotisch*, or old Gothic, was the language of the Goths who lived near the banks of the Lower Danube in the fourth century, and for whom Ulphilas made a translation of the Gospels. [See GERMAN LANGUAGE.] Ulphilas was bishop of those Goths who lived in Mæsia in the time of the Emperor Valens, and the language of his version has been styled Mæso-Gothic. He is supposed to have formed the characters, with slight variations, from the Greek and Latin capitals. Another branch of the Gothic or Gotho-Teutonic language existed in Scandinavia, which German philologists have called *Altnordisch*, or old Norse, and in which the "Edda" is written, and which is still spoken with some variations in Iceland, the Faroe Islands, and parts of Norway. Out of this language the modern Swedish, Danish, and Norwegian sprang.

GOTH'LAND (in Swedish *Gottland*) is an island in the Baltic, 70 miles long and 22 broad; it lies between 56° 55′ and 58° N. lat., and between 18° 10′ and 19° 20′ E. lon. The population is 60,000. The island is of special importance from its geographical position and natural capabilities, for, in a strategic point of view, it has been styled "a padlock upon the Gulfs of Finland and Bothnia," by means of which a strong hand might lock up the Russian navy, and command the navigation of the Baltic. The island has a considerable number of swamps whence peat is obtained, productive fisheries, woods of oak and pine, a soil capable of yielding abundant harvests, and harbours of sufficient depth for war steamers. The climate is remarkably mild for the region; the inhabitants do not calculate upon having more than eight days' sledge driving in winter. Horses and sheep remain without cover the whole season, and the grape, mulberry, and walnut ripen in favourable summers. The island possesses a fertile soil, abundance of game, fine woods, pleasant villages, and has long been celebrated for a race of diminutive and graceful ponies.

Wisby, on the west coast, is the capital. From the eighth to the eleventh century an extensive trade was carried on between Arabia and Gothland. In 1361 Vladimir III., king of Denmark, took this territory from the Swedes. By the treaty of 1644 it again became their property; and since then has continued in their possession, with the exception of a short period in 1807, when it was occupied by the Russians.

Gothland, or Gotaland, was a name formerly given to the south portion of Sweden, containing one-fourth of the whole kingdom. It is now divided into 12 lans.

GOTHOFRI'DUS (DENIS GODEFROY) was born in Paris in 1549. He was an ardent student of literature generally; but the civil law was his chief object, and in pursuance of it he studied under the great teachers of Louvain, Cologne, and Heidelberg. In 1595 he was made professor of law at Strasburg, having left Geneva, where he had been professor since 1580. He wrote comments on Cicero, Alessandro, Seneca, and Virgil. But the bulk of his works are devoted to jurisprudence. Of these alone the bare titles would fill more than the proper limits of this notice. His dissertations on jurisprudence may be all said, however, to come to a focus in his edition of the Corpus Juris, or simply of the Justinian Law. This title, now so familiar, was first applied to its present use by Gothofridus, as he was indeed the first to give to the world, in a complete and practical shape, the great collection on which all our European systems, not even excepting that of England, have to a greater or less extent been founded. The first edition was published at Leyden in 1583. The edition by the Elzevirs in 1663 is understood to be the best. There have been numerous editions of the Corpus according to the text of Gothofridus, but without his notes, in a convenient octavo form for hand use. These notes, so extensive that the text is sometimes merely a narrow strip between them, are still extremely valuable to the civilian. But it is scarcely possible to appreciate their importance to the students of the seventeenth century, for whom they embodied, with reference to each passage in the text, almost everything worth knowing that had been said to illustrate it either by ancient or modern jurists. In 1604 the elector palatine secured the services of this great jurist. He taught at Heidelberg, and returned there to pursue his labours after heading a mission to the court of France; but the troubles of the palatine came, and drove him in his old age from this honourable retreat. He died at Strasburg in 1622. His son Jacques was also a jurist of considerable ability. His edition of the Theodosian Code annotated, was his best work. He died in 1652.

GOTHS or **GOTHI**, a powerful northern nation. The name "Goths" appears first in history in the third century, and it was then used by the Roman writers as synonymous with the more ancient one of Getæ, a people who lived on the banks of the Lower Danube. The Greek writers generally considered the Getæ or Goths as a Scythian tribe, but we now know them to have been a Teutonic tribe. The Getæ are mentioned in the time of Augustus as living on the banks of the Danube; and a century later Tacitus mentions the Gothones inhabiting the shores of the Baltic as a German tribe, while he considers the Gothini, who lived in Southern Germany, as Celts or Gauls. As an ethnologist, however, Tacitus is but a blind guide. About the middle of the third century the Goths crossed the Dniester and devastated Dacia and Thrace. The Emperor Decius lost his life in opposing them in Mæsia, in 251, after which his successor, Gallus, induced them by money to withdraw to the Dniester. They then spread eastwards, and occupied the country about the Cimmerian Bosphorus, from whence they sailed across the Euxine, occupied Trebizond, and ravaged Bithynia. In the year 269 they landed in Macedonia, but were defeated by the Emperor Claudius II. Three years after Aurelian gave up Dacia to the Goths,

now called Visigoths, or Western Goths, while those who still dwelt by the shores of the Baltic were the Eastern Goths, or Ostrogoths. Constantine II. allowed a part of the Goths of Dacia to settle in Mæsia, and it was for them that Ulphilas translated the Scriptures into Mæso-Gothic. [See GOTHIC LANGUAGE.] About 375 the Huns fell upon the Ostrogoths, and drove them upon the Visigoths, who were living north of the Danube. The latter implored the Roman commander to allow them to cross that river and take shelter in the empire. The Emperor Valens consented, and many of them were allowed to settle in Mæsia under Fritigern; but they soon quarrelled with the Romans, and defeated and killed Valens. From that time they exercised great influence over the Byzantine court. Towards the end of the fourth century Alaric, king of the Visigoths, invaded North Italy, but was defeated by Stilicho near Verona. He came again, however, a few years after, and plundered Rome, 410. His successor, Ataulphus (Atholf), made peace with the empire, and repaired to the south of Gaul, where the Visigoths founded a kingdom, whose capital was Toulouse. Ataulphus married the sister of the Emperor Honorius, and left the empire in peace. In 812 he passed into Spain, where a Visigothic dynasty which he founded reigned for more than two centuries. The last Visigothic king, Rodrigo, fell before the Saracens in 711.

The Ostrogoths, who had settled in Pannonia, retiring from the pressure of the invading Huns, extended their dominion over Noricum, Rhætia, and Illyricum; about 489 they invaded Italy under Theodoric, and defeated Odoacer, who had assumed the title of King of Italy, a title which Theodoric then took for himself with the consent of the Eastern emperor. Theodoric was a great prince, and ruled Italy wisely and well from his capital at Ravenna till his death in 526; but his successors degenerated, and the Gothic dominion over Italy was overthrown by Narses, the general of Justinian, in 554. From that time the Goths figure no longer as a power in the history of Western Europe, except in Spain. Their name was, however, perpetuated in Scandinavia, where a kingdom of Gothia existed till the twelfth century, distinct from Sweden Proper, until in 1161 both crowns were united on the head of Charles VII. (Swerkerson), who assumed the title of King of the Swedes and the Goths, which his successors bear to this day. The Swedish province and city of Gothenburg and the island of Gothland still preserve the memory of the ancient conquerors of the north.

GOT'TINGEN, a town of Germany in the former kingdom of Hanover, is situated about 60 miles south of Hanover. It is built on both sides of the New Leina, an artificial arm of the Leina. About the year 1360 it became a member of the great Hanseatic League, but it owes its modern celebrity to the university. The town is surrounded by ramparts, which have been levelled and planted with trees. It is divided into the Old Town, New Town, and Masch. It has four gates and some inconsiderable suburbs. It is in general well built, and the streets are mostly broad, straight, and paved with basalt. There are three squares or open spaces, and the town has Lutheran, Reformed Lutheran, and Roman Catholic churches, a guildhall, and an hospital.

The chief establishment of Göttingen is the university, founded in 1784 by George II., and attended generally by about 900 students. The immediate control is vested in a pro-rector, one of the regular professors. It has four faculties: theology, law, medicine, and philosophy. The library contains upwards of 400,000 volumes and 5000 manuscripts. There are an ecclesiastical school, museums, and apparatus rooms, an observatory, chemical laboratory, an anatomical theatre and lecture rooms, a veterinary school, a clinical establishment and medico-chirurgical hospital, a philological seminary, a botanic garden, and a nursery, and a hall endowed with funds towards providing meals for poor students; the whole is under the management of the senate and professors. The reputation of the university has declined since 1837, when seven of the professors were deprived of their chairs for holding liberal political opinions. There are yearly exhibitions, or stipends, for the benefit of students with slender means. Göttingen has also a Royal Society of Sciences, a German Society, a gymnasium, a school for females of the upper class, a school of industry, and other schools. The expenditure of those connected with the university forms the principal means of subsistence to the inhabitants, but they have also considerable manufactures of woollens, tobacco, leather, soap and candles, musical and scientific instruments, stockings, &c. The population of the town in 1881 was 19,963.

GOU'DA or **TER GOUW**, a town of the Netherlands, in the province of South Holland, situated 11 miles N.E. of Rotterdam, on the right bank of the Yssel, at the point where it is joined by the Gouw. It is a large town, with a population of 16,000. The town has several churches, hospitals, an orphan house, Latin school, library with curious MSS., and a town museum; very extensive tobacco-pipe factories; brickworks, the clay for the supply of which is taken from the bed of the Yssel; rope-walks, gin-distilleries, and breweries. The most important buildings are the town-house and the church dedicated to St. John, which is famous for its splendid painted windows; both these buildings stand in the great square, in which markets are held. Gouda numbers also among its industrial products tobacco, woollen cloth, cordage, and sail-cloth, but its manufactures have greatly declined, though it is still famous as a cheese market.

GOUDIMEL, CLAUDE, the famous Huguenot psalm-writer, was born near Avignon about 1510. Like all fine musicians of the time he soon gravitated towards Rome, where he produced splendid musical work, chiefly Catholic church work, in the strict contrapuntal style of that period. He founded one of the first known schools of music there in 1540, and Palestrina became one of his pupils, as did other afterwards celebrated musicians, such as Animuccia, inventor of the oratorio, &c. In 1555 he went to Paris, and here at first set the odes of Horace to music. This he followed by a setting of the psalms of David in the Latin Vulgate, which he never fully completed. But a metrical paraphrase of the psalms in French, by the Huguenots Clement Marot and Theodore de Beza, he completely set to four-part vocal harmony in a simple chorale-like fashion, and this most interesting and valuable work was printed at Lyons in 1565. The melodies were always in the tenor part, and were sometimes Goudimel's own, sometimes the composition of the early German reformers. Goudimel, though now a Huguenot, was moderate in his opinions. His psalms even became popular enough for private worship among Roman Catholics, and to require a solemn examination and approval at the hands of the University of the Sorbonne. When, however, the intrigues of Cathérine de Médicis prevailed, and the Huguenots fell into suspicion, Goudimel, as lending attractiveness to their services, became particularly obnoxious. Calvin had also recently adopted his psalms at Geneva. The result was that at the St. Bartholomew massacre at Lyons (simultaneous with that at Paris) Goudimel was thrown into the Rhone by the Roman Catholics, 24th August, 1572.

GOUGH, LORD, was born 3rd November, 1779, at Woodstown, in the county of Limerick, in Ireland. At thirteen years of age he obtained a commission in his father's regiment of militia, from which he was transferred to the line, his commission in the army dating 7th August, 1794. He had gained a high reputation when, in 1809, he was sent to the Peninsula to join the army under the Duke of Wellington, who recommended him for promotion to a lieutenant-colonelcy for his distinguished conduct at the battle of Talavera, where he was severely wounded.

He distinguished himself on several other occasions during the war, and at its close returned to England and enjoyed a brief respite from military duties. In 1830, at the age of fifty-one, he attained the rank of field officer; and seven years later he proceeded to India in order to take the command of the Mysore division of the army. Difficulties arose at Canton, which led to the first British war in China; and an army of 4500 effective soldiers was put under the command of Gough. On the conclusion of the treaty of Nankin in 1842, Gough was created a baronet, and invested with the grand cross of the Bath. In August, 1843, he was appointed to the post of commander-in-chief in India. The Sikhs had long shown signs of mischief, and in 1845 they crossed the Sutlej in vast numbers. Gough gave battle to them at Moodkee and at Firozshah, where he carried by assault the intrenched camp of the enemy. This he followed up by a third victory, that of Sobraon, which resulted in the total rout of the Sikhs. He was created a peer in 1846. In 1848 the Sikh War broke out again, when Lord Gough met and defeated them the fourth time at Ramnuggur, and again at Chillianwallah; but his crowning victory was at Gujerat, where the Sikh power was finally broken. He was afterwards created Viscount Gough, and received a field-marshal's baton in 1862. He died 2nd March, 1869.

GOU'RA is a genus of PIGEONS (Columbidæ). Many of the gouras are exceedingly beautiful. Of these the *Goura coronata* and *Goura Victoria* (or Queen's pigeon) may be named. The head of the latter is surmounted by a splendid crest, each feather of which is spread out into a spoon-shaped form at the point, where the colour is blue, edged with white. *Goura coronata* (the crowned pigeon) is the largest living species of its order. It inhabits New Guinea and some of the adjacent islands. It feeds on seeds and berries. The nest is placed upon the branch of a tree, and contains only two eggs. The crowned pigeon is from 28 to 30 inches in length. The general colour of its plumage is a pale bluish-gray, but the feathers of the back, the scapulars, and lesser wing-coverts are black at the base and purplish-brown at the apex, and the greater wing-coverts are also purplish-brown, with a broad white band across their middle. The quill feathers of the wings and tail are gray. The most striking character presented by the bird consists in an elegant and ample crest of delicate decomposed plumes with which the head is adorned. This is of the same pale bluish-gray colour as the plumage of the head and lower parts.

GOURAM'I (*Osphromenus olfax*) is a fish belonging to the same family as the climbing perch (ANABAS). The gourami has been introduced into Penang, Malacca, Mauritius, and Cayenne, having been originally brought from Java, Sumatra, Borneo, and some other islands. It is very easily acclimatized, and becomes so tame as to approach the hand of the feeder, and will rise to flies, beetles, and certain flowers. It has also been introduced into Australia. It is highly esteemed for the table. The gouramis are nest-building fishes. Mr. F. Day (*Journ. Linnean Society* xv. 81) gives the following account of their habits at the Mauritius:—"During the breeding-season they frequent the sides of tanks, where shelter is afforded them by the grasses and weeds growing in the water. For several days they are very active, passing in and out of their grassy cover, and in some places thickening it by entangling all trailing shoots and forming what is generally considered the spot under which the ova are deposited. They continue to watch this place with the greatest vigilance, driving away any interloping fish; and at the end of a month numerous fry appear, over which the old gouramis keep guard many days. The body is compressed; the head small, terminating in a short snout. There are small fixed teeth in the jaws. The dorsal fin has a moderate number of spines; the anal spines are more numerous. The first ray of the ventral fin is produced into a long filament. The gourami attains the size of a large turbot.

GOURD, a kind of fruit obtained from various plants of the order CUCURBITACEÆ. In fact the word gourd is but *Cucurbita* modified. In countries having hot and dry summers the different kinds of this fruit are held in high estimation, and are a valuable article of consumption, acquiring a very large size, abounding in nutritious matter, and being moreover very wholesome. The largest is the kind called *potiron jaune* by the French, which sometimes weighs about 2 cwts. The best kind of gourds belong to the genus Cucurbita. BOTTLE-GOURDS, which are bitter and dangerously drastic, are the fruit of *Lagenaria vulgaris* (the true gourd of the French), while what is called the colocynth gourd, a powerful purgative, is in reality a kind of melon, the *Citrullus colocynthis.*

The Common or Pumpkin Gourd (*Cucurbita Pepo*) is a globose, oblong or egg-shaped fruit, varying from the size of an apple to 70 lbs. in weight. In France it is known as *courge pèpon* or *citrouille.* The leaves are heart-shaped, with five acute lobes and stalks marked with furrows. It grows readily, and is used either as a vegetable, or in soups, or in the form of pumpkin pie. It has been cultivated in England since 1570. In the United States it is grown very extensively. De Candolle (in "L'Origine des

Wild Gourd (*Cucumis prophetarum*).

Plantes Cultivées," 1883) comes to the conclusion, from botanical considerations, that the pumpkin gourd was introduced from America to Europe, and that it is a native of Mexico or Texas. A confirmation of this opinion is derived from the fact that the first figures of this plant appear in Dodoens' "Stirpium Historiæ," 1557, after the discovery of America. The Vegetable Marrow (*Cucurbita ovifera* of Linnæus) is considered to be a mere variety of the common gourd, and since 1815 has taken its place in England in ordinary cultivation.

The Melon Pumpkin or Great Gourd (*Cucurbita maxima*), the *potiron* of the French, is very much the largest kind, sometimes being over 200 lbs. in weight and 8 feet in circumference. The fruit is globose, generally flattened at

top and bottom. The lobes of the leaves are rounded, the stalks are not furrowed, and the corolla lobes are curved back. It is cultivated largely in the south of Europe and the United States. Its native country is doubtful; some botanists assign it an American origin, while others, with De Candolle, consider it more probable that this species is indigenous in the Old World and was introduced into America. Hooker, in the "Flora of Tropical Africa," says that it has been found "apparently indigenous" on the banks of the Niger in Guinea.

The Squash (*Cucurbita Melopepo*) is now placed as a variety of *Cucurbita Pepo*. It forms a kind of bush; the fruit is generally very flat, and varieties are known as Elector's Hat, Turk's Hat, and Patisson. It is one of the best of the gourds.

The Orange Gourd (*Cucurbita aurantia*) is so named from the brilliant colour of the fruit. It sometimes has a bitter taste, and is then dangerous from the colocynth developed in it.

The Musk Gourd (*Cucurbita moschata*) derives its name from the musky smell of the fruit. The plant is covered with downy hairs, the stalk of the fruit is five-angled, and the fruit itself is covered more or less with a glaucous efflorescence. The calyx-lobes often terminate in a leafy-like limb.

The Fig-leaved Gourd (*Cucurbita ficifolia* of Bouché, *Cucurbita melanosperma* of Braun) has only been introduced into gardens since 1850. It has blackish or brownish seeds, and is a perennial.

The wild gourd of the Bible was supposed to be *Cucumis prophetarum*. But it is more probable that the word used in Jonah refers to the castor-oil plant; while the poisonous wild gourd of 2 Kings (for which a different Hebrew word is used) refers probably either to the colocynth or to the squirting cucumber (ELATERIUM).

GOUT (Lat. *gutta*, a drop), *Arthritis*, or *Podagra*. It may be defined to be an inflammatory affection of the joints, arising from some peculiar morbid action in the system. It is mostly an hereditary disease, coming on without any evident external cause, generally preceded by disorder of the digestive organs, and accompanied by a plethoric state of the system. The inflammation attacks the smaller joints, particularly the first joint of the great toe, and returns at intervals, various joints or parts becoming affected after repeated attacks.

A paroxysm of gout is generally preceded by some constitutional disturbance, though it may attack a person suddenly who is apparently in good health. It is commonly ushered in by a disordered state of the whole system; the circulating, nervous, digestive, and secreting organs are all out of order. The pulse is frequent and full; there is a feeling of repletion and oppression, drowsiness, or restlessness; general lassitude and depression of spirits; flatulence; irregular appetite; costiveness; and high-coloured urine, which deposits lithic acid on cooling. Lithic acid is also found to exist in the blood. The local affection generally commences suddenly in the middle of the night. The patient is awakened at two or three o'clock in the morning with acute pain in the ball of the great toe, accompanied with a feeling of heat and stiffness of the part; chilliness and fever come on, which gradually abate as the pain increases; the latter becomes more violent every hour, having a burning or gnawing character. This generally continues to the middle of the following night, although in slight cases it may remit after a few hours' duration. A gentle perspiration then breaks out, and the patient falls asleep. The next morning the toe is shining, red, and swelled; the veins of the foot are very much distended, and the joint is excessively tender. Exacerbations, becoming less violent each time, recur for several nights, and then the attack declines. The joint remains swelled and weak for some days, and there is violent itching, followed by desquamation of the cuticle; after which all disease ceases, and the patient feels better both in body and mind than before the attack.

It is very common, when persons have had gout for a length of time, for various internal organs to become diseased. The inflammation may suddenly disappear from a joint, and some serious internal affection, as apoplexy or gastritis, unexpectedly make its appearance. This is called retrocedent or displaced gout. The internal affections which thus arise are often caused by the patient's imprudence, and sometimes by injudicious treatment, as the application of cold to the inflamed joint.

Gout is more frequently met with in persons of vigorous and robust constitutions than in those of spare habit, and is more common in men than in women; this comparative immunity of the female sex seems to be owing in a great measure to their more temperate habits of life, though many physicians ascribe it rather to the existence of certain periodical functional peculiarities of the female sex than to any essential difference in the mode of life. Where gout occurs in women it rarely makes its appearance till after the age of forty-five. Persons of advanced and middle age are more liable to gout than those of early life. It does not commonly appear in males till after the age of thirty-five, though where the predisposition is strong it may occur even before puberty. Hereditary predisposition is doubtless one of the strongest causes of gout, and where this tendency exists the disease may take place under circumstances which would not otherwise have power to produce it. Hence persons who are conscious of an hereditary taint should guard with particular care against the causes which excite gouty action. Slight causes will bring on an attack of gout in those who are liable to it. It has also been found that where the hereditary tendency has been counteracted by an abstemious and careful mode of living it has reappeared in the second generation when such precautions have been neglected, with all its original intensity. Hence the grandchildren of gouty subjects, as well as those who are direct descendants, are called upon to take especial care of their mode of living.

With regard to the treatment of gout it is desirable during an attack that the patient should be kept in a warm room, and should remain as quiet as possible. The limb affected should be wrapped in flannel and kept in a horizontal position, on no account being allowed to hang down or support its own weight. When the pain is considerable the local application of warm fomentations will be found useful. These may consist only of water, or water to which a little of the tinctures of opium or belladonna has been added. Poppy fomentations also are often very serviceable. Other local applications are the belladonna liniment, tincture of aconite, and contractile collodion mixed with a little tincture of iodine. The latter are painted over the inflamed joint, and often give speedy relief from the severity of the pain. The diet of the patient must be made as low as is compatible with his condition; but while all rich food must be avoided, such articles as milk, barley water, toast and water, arrow-root, tapioca, sago, biscuits, and toasted bread may be taken without restriction. Where patients are advanced in life, or are suffering from prolonged and repeated attacks, more nourishing articles of diet may be required; but care must be taken that they are such as are light and easy of digestion. In almost every case all alcoholic stimulants should be interdicted during an attack, and where, owing to previous habits or present condition, it may be necessary to use it, the quantity should be strictly regulated, well diluted, and taken only with the food.

With regard to medicines, there is one drug which has long held the first place in the treatment of gout—viz., colchicum—and this certainly is the best internal remedy both for acute and chronic gout. Its action on the system seems scarcely to be understood at present, but experience

has shown that the effect of this drug upon gout is almost as marked as that of quinine upon ague. It must be administered with care, for it does not suit all cases; but where it can be taken it will quickly relieve the inflammation and shorten the paroxysms of pain. It may either be administered in one full dose, say a drachm of colchicum wine in a little water; in drop doses taken every twenty minutes, half hour, or hourly; or in doses of from ten to twenty minims every four or six hours. The bowels must be kept in free action, saline purgatives being the best for this purpose.

It must always be remembered after the first attack of gout that unless great care be taken it will be surely followed by others, and that these will have a tendency to recur at ever shortening intervals until chronic gout be established, and life both embittered and shortened. If, however, due care is taken, and an abstemious and active mode of life is persisted in, the disease may be thoroughly eradicated from the system and will never return. Strict temperance in eating and drinking, regular exercise in the open air, the avoidance of too severe mental application, and attention to the general health, while excellent rules for all persons are enforced by special penalties upon such as are liable to gout.

The irregular forms of gout attacking the internal organs must be treated according to their character, and call for the best professional advice that can be obtained. During late years lithia has been used with great success for the removal of the chalky deposits left in the joints after repeated attacks of gout. A solution of this salt applied by means of lint or rag to the part affected, though tedious in application, has often served to restore a useful degree of motion to previously stiff and useless joints.

GOVERNMENT is a word used in more than one sense. (1) It denotes the *act of governing*, as when we speak of the business of government; (2) the *persons who govern* are called the government, as when we speak of the French government, Russian government, &c.; (3) the word government is used for the phrase *form of government*, as when we speak of a monarchical, aristocratic, or republican government; or of the English or French government, meaning the English or French form of government, or the English or French constitution.

The science of government, in the first of the three senses, is more commonly called the science of legislation. So the art which flows from this science, or the art of governing, is called the art of legislation. In the present article we shall concern ourselves exclusively with that sense of the word government in which it stands for the phrase "form of government," confining ourselves to an enumeration of the various forms of government.

1. A government consists either of one person or of more than one. When it consists of one person only, the appropriate name for the form of government would be *monarchy*. But this name is generally, in common speech, bestowed on a particular class of governments of more than one person; while a government of one only is called by the names of *autocracy*, *absolute monarchy*, *despotism*, and *tyranny*. The essence of this form of government is the complete dependence of the governed on the will of one person, which is well expressed by the true original meaning of the terms despotism and tyranny; and the sense of disapprobation which now hangs about these terms is to be traced to the arbitrary conduct of the generality of despots or tyrants.

2. A government of more than one may consist of a body, all of whose members are appointed in the same way, or it may be mixed, compound, or consist of heterogeneous parts. When the members of the one governing body, if hereditary, are a decided minority of the state, or if, deriving their powers from without their own body, they so derive them from a portion of the state which is yet a decided minority, the government is called by the names *aristocracy* and *oligarchy*. The latter term is used where the minority is very small, and the term aristocracy where it is not; aristocracy, and not oligarchy, should also be always employed where the members of the governing body derive their powers from without, or where the body is elective. Further, usually the term aristocracy denotes an aristocracy by birth, that is, a government by nobles (the word means "government by the best"), whereas the term oligarchy has no such necessary meaning. An oligarchy, as Venice, may be aristocratic in the sense of "nobly born," but usually it contains some men of low station, who from fortuitous circumstances have won the power of the sword or of the purse, and cannot be disregarded in the struggle for power.

3. When, on the other hand, the members of the one governing body either themselves constitute, or derive their powers from, a portion of the state which is a decided majority, the government is called a *democracy*.

These three forms of government—namely, absolute monarchy or despotism, aristocracy or oligarchy, and democracy—are commonly called (as being governments of one person, or of one homogeneous body) pure forms of government, in contradistinction to the mixed forms which yet remain to be mentioned. The division of forms of government into pure and mixed is a complete division, which the common division into monarchy, aristocracy, and democracy is not.

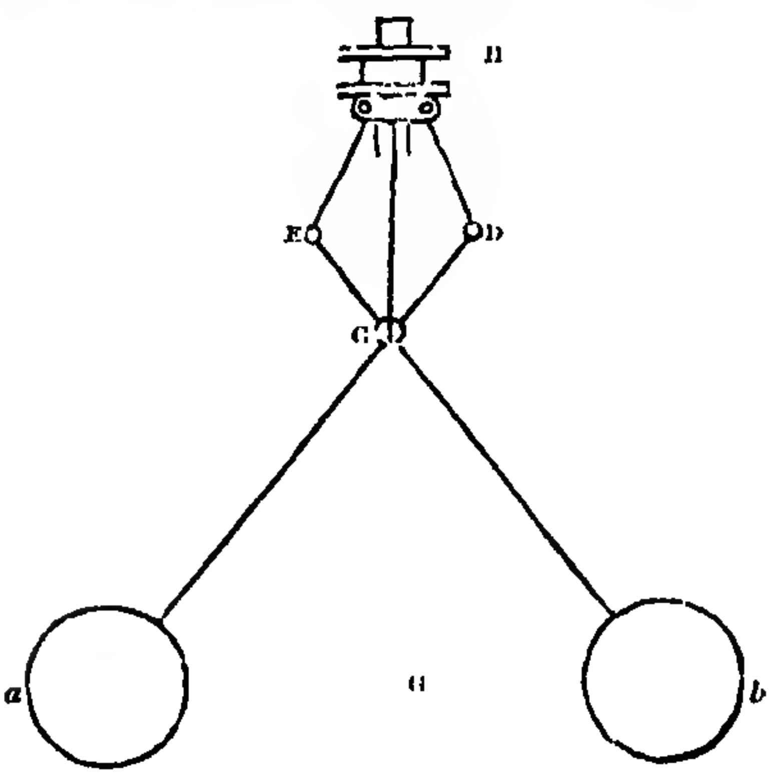
4. A mixed form of government is one compounded of the whole or of any two of the three elements which exist separately in the three pure forms of government, and also of individuals or bodies deriving their powers from different portions of the state, even though each of these different portions be a decided majority of the state. It is not necessary to enumerate all the mixed forms of government which arise from all the possible combinations. Those with which we are familiar may be divided into two classes, according as an hereditary chief does or does not enter into their composition.

Governments which contain an hereditary chief united either with an aristocratic and a democratic body, or with either by itself, are generally called *monarchies*, or more correctly speaking, *limited* monarchies, to distinguish them from the governments of one only, to which, as we have said, the name monarchy more appropriately belongs, but to which, without the epithet *absolute* being prefixed, it is seldom or never applied.

As regards the governments of which an hereditary chief forms no part, we may observe that the combinations of an elective chief with one or more democratic bodies are the only unions which possess any interest; if indeed, judging from the past, we may not also say that they are the only ones which are practicable. And having premised this, we may say that the governments into the composition of which an hereditary chief does not enter are generally called *republics* or *representative governments*, or again *pure representative governments*, to distinguish these from the forms of government in which a democratic body is united either with an hereditary chief and aristocratic body together, or with either of these by itself.

GOVERNOR BALLS, an ingenious combination of the principles of the pendulum and the tendency to fly off at a tangent (by the persistency of motion in the straight line) whenever whirling motion is imparted from a centre, a tendency usually most inaptly named "the centrifugal force." The following diagram gives a good notion of the operation of such a conical pendulum as governor to a steam engine. It is easy to see the action of the balls A and B upon the sliding collar at H. Thus the centrifugal force being inversely as the square of the time of revolution, if the motion be accelerated, the balls, when the axis G is rapidly whirling round by the action of a pinion at

the point C, will diverge and shorten their perpendicular distance below the centre C, and consequently pull down the collar H, with which they communicate through the rods A D, D H, and B E, E H, thereby shortening the diagonal H C of the parallelogram D E. The collar H acts upon the end of the lever communicating with the throttle valve of the steam-engine in various ways, and by various combinations of links. As H is displaced the throttle valve is



wholly or partly closed, as the case may be, and the steam wholly or partly cut off. The governor balls therefore regulate the pace of the engine, for directly it begins to go faster than the pace they are set for the motive power is withdrawn by their means, but as soon as the pace falls sufficiently to allow them to drop, H rises and the throttle valve opens again, and power is again supplied.

GOWER, JOHN ("the moral Gower"), an early English writer, was born in the first half of the fourteenth century. Whether he was older or younger than Chaucer is doubtful; certain it is that they were friends, probably from their college days, and Gower outlived Chaucer by eight years. Gower studied the law, and it has been said that he was for some time chief-justice of the common pleas; but the assertion wants proof. He was of a good Kentish family, and was attached to the Duke of Gloucester, uncle of Richard II. Like Chaucer he took part in censuring the vices of the ecclesiastics of the time.

Gower's works are:—(1) "Speculum Meditantis," a collection in French verse of precepts and examples of chastity; (2) "Vox Clamantis," a Latin poem in seven books on the insurrection of Wat Tyler under Richard II., his best work; (3) "Confessio Amantis," which is written for the most part in English octave verse, with interspersed Latin elegiacs and Latin prose tables of contents, written at the express desire of Richard II. in 1393. This poem shows a desire on Gower's part to conform to the taste for English poetry which Chaucer had awakened among his countrymen. To compare the two men as poets, as is so often done, is absurd. Chaucer is one of the very greatest of poets; Gower is, in truth, hardly a poet at all, but rather a moral philosopher writing in the forms of poetry and fiction. When Richard turned tyrant Gower threw up his court-living and retired to St. Mary Overy, where he wrote a history of the king's reign, "The Tripartite Chronicle," dividing it into three periods, and telling his tale of ruin very accurately and fairly. Gower became blind in his later years. He died in 1402, and was buried in St. Saviour's, Southwark, to which church he was a benefactor, and where a very beautiful monument was erected to him, and now remains in fine preservation.

GO'ZO or **GOZ'ZO**, a small island in the Mediterranean, included in the Maltese group. It is 4 miles north-west of and separated from Malta by a strait, in which are the islets of Comino and Cominotto. It is about 9 miles long and nearly 4 miles broad. The coast is girded by rocks that afford very few openings for landing, though it has two fair harbours; the centre rises into several heights, the most remarkable of which is crowned by the fort of *Rabetto*. Although the surface is very rocky and the soil thin, yet it produces good crops; much cotton in particular is raised, and the spinning and culture of this plant give employment to the natives; fish is abundant. The island, formerly belonging to the Knights of St. John, has followed the fortunes of Malta, and is now British. Of antiquarian interest are a Cyclopean building known as the Giant's Tower, and numerous Roman remains.

GOZ'ZOLI, BENOZZO, a celebrated old Italian painter, born at Florence in 1420. He was the pupil of Fra Angelia da Fiesole, whose works he studiously imitated. Many of Gozzoli's frescos still exist in a tolerable state of preservation. Those in the Campo Santo at Pisa are considered the best. The National Gallery possesses two good easel pictures of this master. Gozzoli died in 1478.

GRAAL or **GRAIL, THE HOLY,** or **SAN GREAL**, is the name given in Christian myth to the shallow bowl or dish supposed to have been used by Christ at the Last Supper, and afterwards to have been employed by Joseph of Arimathea to catch the drops of blood that came from the wounds of the Saviour as he was removed from the cross. Connected thus with sacramental symbolism, the name is thought to have sprung from a corruption of the Latin *graduale*, applied to the sentences read by the Romish priest at the celebration of the eucharist as he crosses from the epistle to the gospel side of the altar. A more likely etymology is the popular one from *sang real* (the true blood), by the agglutination of the *g* to the second word. But the name is truly *san graal*, the holy grail, and the latter word comes from *cratella*, a diminutive of *crater*, a bowl; which in Low Latin became *gradale*, whence the Old French word *graal*, dish. The legend narrates that the chalice, having been given into the charge of Joseph, and having kept him from pain and hunger in his prison for forty-two years, was brought by him to Britain after his release. The son of Joseph, a bishop, instituted the order of the Round Table. The knights sat round, the invisible graal believed to be in their midst, and one seat was left empty, the "siege perilous," wherein if any impure man sat the earth straightway swallowed him up. The knights quickly fell from perfect virtue and the graal at once disappeared. The "quest of the graal" was therefore a high emprise, and the stainless Sir Galahad, of all King Arthur's knights, alone succeeded in it. But though he saw it his comrades saw it not. The tale became interwoven with Arthurian lore in the twelfth century, it is supposed by the means of Walter Map. The use made of this legend by Tennyson in his "Idyls of the King" will be familiar to most readers. The added legend of Parzival or Parsifal (Sir Percivale) is due to the German poet Wolfram von Eschenbach (late twelfth century), and this has been made the subject of a very beautiful mystical opera-drama by Richard Wagner in our own days. Mediæval tradition reported the graal to be a cup made of one large emerald, dropped from the crown of the falling Satan. In the Cathedral of San Lorenzo at Genoa is shown a so-called *san graal*, a hexagonal dish of greenish glass, which those of strong imagination may consider to be of emerald.

GRAC'CHUS, TIBERIUS, born B.C. 163, was the son of Tiberius Sempronius Gracchus, who was twice consul, and of Cornelia, daughter of Scipio Africanus. Tiberius Gracchus the Elder died while his sons were young; but Cornelia devoted herself to the education of her children with the most tender anxiety. Tiberius served his first campaign in Africa under his uncle Scipio, and afterwards

as quæstor under Mancinus in the Numantine War. His name, which the Numantines respected from remembering his father's virtues, is said to have procured the terms under which Mancinus obtained safety for his army; but the senate was so much displeased at the unfavourable nature of the terms, that they resolved on giving up all the principal officers to the Numantines. It was, however, ultimately decided to send Mancinus as the real criminal, and to spare the other officers for the sake of Gracchus. This treatment roused Gracchus against the senate, and made him the friend of the poor, and three years afterwards he began his short career as a political agitator. He was elected tribune of the plebs, B.C. 133.

The long wars in which the Romans had been engaged led to the introduction of an enormous number of slaves into Italy, who tilled the large estates of the rich to the exclusion of the regular labourers, once free possessors of the soil; and Italy presented the scene of a country whose only cultivators were foreign slaves, and which was possessed by a small and tyrannous oligarchy. These causes, acting on a disposition at once ambitious and humane, and aided by the suggestions of his mother, and by the general voice of the people expressed in placards and memorials addressed to him as to their preserver and champion, combined in inducing Tiberius Gracchus to attempt the revival of the Licinian Rogations. He appears to have had in view the employment of freemen in preference to slaves, and the equitable division of the public land. Three commissioners were to be appointed to superintend the working of the new law which Gracchus proposed. Crowds arrived from all parts of the country to support him, and there appeared no doubt which way the matter would go when left to the tribes. The aristocracy, by securing the veto of M. Octavius, one of the tribunes, quashed the proceedings whenever the law was brought on, which violent mode of opposition led Gracchus to exercise his own veto as a tribune on other questions during his memorable year of office, and throw the government into complete helplessness by stopping all the business of country.

Thus far the contest had been lawful, but at this juncture Gracchus, by a vote of the tribes, ejected Octavius from the tribuneship. The Agrarian law was passed, and Gracchus himself, his brother Caius, and his father-in-law Appius Claudius, were appointed the commissioners. All state lands not let on lease were resumed, subject to compensation for improvements and to a gift to the late occupying nobleman of 500 acres for himself and 250 for each of his sons—a sufficiently handsome settlement of a wholesale spoliation, one would have thought, because these men had absolutely paid nothing whatever for the lands they held. On the other hand they and their families had enjoyed possession for so long that they looked upon the land as their own. While things were in this state, Attalus, king of Pergamus, bequeathed his kingdom and property to the Roman people; and Gracchus proposed to divide the treasure among the recipients of land under the new law, to enable them to stock their farms. This brought matters to a greater pitch of distrust than ever. Gracchus was accused by one senator of aspiring to tyranny, and by another of having violated the sanctity of the tribune's office in deposing Octavius. At this juncture Gracchus seems to have trembled for that popularity which alone preserved him from impeachment, and, lest it should fail, endeavoured to secure his own re-election to the office of tribune. The other party had demurred as to a man's eligibility to the office two years in succession, and on the day of election this point occupied the assembly till nightfall. Next morning, accompanied by a crowd of partisans, he went to the Capitol, and, on hearing that the senate had determined to oppose him by force, armed his followers with staves. At this juncture Scipio Nasica, having in vain called on the consul to take measures for the safety of the state, issued from the Temple of Faith, where the senate had assembled, followed by the whole nobility of Rome, put the mob to flight, seized their weapons, and attacked all who fell in their way. About 300 fell, and among the slain was Gracchus, B.C. 133.

GRAC'CHUS, CAIUS, was nine years younger than Tiberius, and at his death was left with Appius Claudius as commissioner for carrying out the Agrarian law; but Caius refrained from taking any part in public affairs for more than ten years after that event. During this time the provisions of his brother's law were being carried out by Carbo and Flaccus; but he does not seem to have begun his career as an independent political leader until the year 123 B.C., when, on his return from Sardinia, where he had been for two years, he was elected tribune of the plebs. He now proposed various measures, one of which was a poor-law, by which a monthly distribution of corn was made to the people at an almost nominal price. A large number of needy citizens was thus attracted to the capital, and formed a permanent working majority at elections.

Gracchus now possessed unlimited power with the populace, and at the end of the year he was again chosen. His second tribuneship was mostly employed in passing laws reducing the power of the senate, and in a series of bold propositions respecting colonies, in which matter the aristocratical agent, Livius Drusus, outbid him, and, having won the confidence of the people by his apparent disinterestedness, ventured (being himself a tribune) to interpose his veto on one of Gracchus' measures. The appointment of Gracchus to the office of commissioner for planting a colony at Carthage took him away from Rome, and soon after his return a proposal was made to repeal the law which he had been engaged in carrying out. He was now a private man, as his second tribuneship had expired, but as such he opposed the proposal, and united with Flaccus, one of the commissioners of the Agrarian law. His partisans collected at the Capitol on the day of deliberation, the nobles also assembled with a large force, and by their conduct broke up the assembly. The senate gave the consul, Opimius, full powers to maintain order. He collected soldiers and summoned Gracchus and Flaccus to answer for their conduct. They retired to the Aventine, but with very few followers; apparently Gracchus did not care to struggle for life. In the morning the senatorial forces attacked and massacred the small body on the Aventine; and Gracchus, moving aside into a grove with one slave, ran upon his sword, and the slave killed himself also. There seems no doubt that Gracchus had determined to cure the evils of the state by personal government of some sort. His many measures, which space prevents our enumerating, taken all together form a weighty machinery for exalting the power of the people's minister and depressing the senators and knights. Probably, had the people remained true to him, Caius Gracchus and not Julius Cæsar would have been the first Roman emperor. He perished when about thirty-three years of age, B.C. 121.

GRACE, a title assumed by Henry IV. of England on his accession in 1399. The word "excellent" was prefixed to that of "grace" by Henry VI. in 1425, and this title was retained till 1603, when "majesty" only was used by James I. An archbishop or duke in the United Kingdom is addressed as "Your Grace."

GRACE is a term frequently used both in the Old and New Testaments. In the former its general meaning is "favour." In the New Testament it has a greater variety of meaning, and it implies—(1) the free and eternal love of God, which is the source of all good in the universe; (2) the love of God as displayed in the salvation of man from sin; (3) the influence of the ever-present spirit of God upon the souls of all who seek him; (4) the condition of the soul brought about by this influence; it is used (5) to designate

the Christian virtues; and (6) as another term for the doctrines of the gospel, "the word of his grace." This is by no means an exhaustive list, for one industrious commentator has enumerated fifteen different uses of the term in scripture, but in most places the meaning is fixed and sufficiently indicated by the context. In theology the Calvinists have distinguished between "common" and "special" grace, and a similar distinction has been accepted in much of the teaching of other schools. The general love of God to his creatures, and such divine influences as operate beneficially upon moral character, are termed "common;" but it is believed that certain persons are elected for salvation from sin, and to these "special" grace is accorded, by means of which they are justified and sanctified. Like many other terms used in theology this has been the subject of prolonged and fierce controversies, and the nature of "imputed," "efficacious," and "irresistible" grace has been discussed in treatises of considerable length and elaboration. Such distinctions, however, have now chiefly but an historical value, and modern preachers and writers are content for the most part to use the term as generally signifying the love of God towards man, and more especially the display of that love in the pardon and restoration of all those who truly seek him in repentance and faith.

GRACE, DAYS OF. When a bill of exchange became due it was formerly usual to grant what are termed days of grace, that is a short period allowed to the drawee for providing the requisite cash. Originally a gratuitous favour (hence the name), it has been rendered by custom a legal right. The law of the place where the bill is payable governs the allowance or non-allowance of days of grace. The number of days of grace allowed varies considerably in the different countries of Europe, but in Great Britain and Ireland three days are allowed on all bills payable at a certain time after date. If the third day of grace be a Sunday, Good Friday, or other holy day, the bill becomes due the day before; if it be a bank holiday it is due the next day. Bills of exchange payable on demand or at sight are immediately payable on presentment, and by the Act of 1871 days of grace in respect to these were abolished.

GRACE-NOTE, in musical composition, any little note added as an ornament or flourish, according to the taste of the composer or performer.—*Graces* is a term applied for those embellishments incidentally introduced by a performer to give fuller effect to a general composition.

GRACES, THE (Gr. *Charites*, Lat. *Gratiæ*), in ancient mythology, are represented as three young and handsome sisters, the attendants of Venus. Their names were *Aglaia* (the brilliant), *Euphrosyne* (the blooming), and *Thalia* (the merry). They were originally represented as clothed, but in later times the sculptors made them entirely naked. They were invoked to preside at the festive board, at nuptials, at births, &c. Their images were multiplied in sculptures and paintings, and votive inscriptions were affixed to them. Groups of the three Graces have been found, forming one of the most pleasing representations of ancient art; and modern sculptors, Canova among the rest, have rivalled the ancients in reproducing the same subject. Athens and Sparta worshipped a pair of Graces, Athens calling them Auxo and Hegemone, Sparta Kleta and Phaenna (that is, *clash* and *flash*, very military graces, indeed, as suited Sparta's rugged taste). Homer speaks of whole crowds of *charites*, the youngest and loveliest being Pasithea. Another one is Aglaia, companion of Hephaistos, the artist-god; and as Homer also gives Aphrodite to Hephaistos, it would almost seem that Beauty and Grace were meant to be synonymous. Sometimes the Graces are called daughters of Dionysos and Aphrodite, but their generally received paternity is of Zeus, by a daughter of Ocean.

GRAD'UAL (Lat. *gradus*), a part of the Roman Catholic High Mass, originally sung from the steps of the altar (or the AMBO), whence its name. It is a very short phrase, usually from the Psalms, and occurs between the Epistle and the Gospel. Special graduals are given for each day of the year. In the hands of the great composers the short gradual becomes a movement of beauty and power, in the style of the anthem or motet, to which indeed it properly belongs when treated in this elaborate manner. The Alleluia, except in Lent, &c., always follows the gradual in the mass.

The Roman gradual is a collection of church plain-song music, containing not only the graduals properly so called, but all the plain-song melodies for the whole year for high mass. Of course there were as many graduals as there were centres of worship. The Roman gradual was partly arranged by Palestrina from 1576 onward, by command of Gregory XIII., and has superseded all others. The *editio princeps* is the Medicean copy, printed by Paul V., at Rome, in 1614. The current modern authoritative text (these antique copies being now, of course, very rare) is the fine work produced by express authority of Pius IX., by Pustet, at Ratisbon, in 1871. The main parts of the gradual are the music for each separate day for the Introit, Gradual, Alleluia, Versus, Tract, Sequence, Offertory, and Communion, which vary; and the Ordinary of the Mass, with the Asperges, Kyrie, Gloria, Credo, Sanctus, Benedictus, and Agnus Dei, which do not vary. Other responses usually sung are also added, as well as special music for certain days, &c. The music is always printed in "Gregorian notation."

GRADUATION is the name commonly applied to the art of dividing mathematical and astronomical instruments.

Graduation, or as the workmen more generally style it, *dividing*, is performed in two ways, by making a *copy* of a system of divisions already existing, or by *original* dividing. The straight scales and rules which are in common use are divided thus:—The original pattern, and the scale on which the copy is to be laid, are placed side by side, a straight-edge, with a shoulder at right angles, like a carpenter's square, is made to slide along the original, stopping at each division, when a corresponding stroke is cut by the dividing knife on the copy. With care and practice this method admits of considerable accuracy. By making the straight-edge turn on the centre of a divided circle, the divisions of that circle may be copied upon any concentric circle. Common protractors are thus divided, and scales upon circular limbs. The original circle, which may have several orders of divisions for different purposes, is called a *dividing plate*.

Small theodolites and ordinary circular instruments must have been thus divided, though the errors were of course large previous to the invention by Ramsden of his *dividing engine*. The general principle of Ramsden's dividing machines may perhaps be understood by the following description:—A horizontal circle of 4 feet diameter turns upon a vertical axis; the outer edge is ratched, or notched, by an endless screw, one revolution of which carries the circle round 10′; the pressure of the foot upon a treadle turns the screw forward, and there is a series of very ingenious contrivances which enable the divider to turn the screw through any portion of its revolution at each descent of the treadle, and which restore the position of the parts when the foot is taken off, without allowing any return motion to the screw. The circle to be divided is fixed upon the dividing engine, and made concentric with it, and a division cut after each pressure of the foot. The Board of Longitude gave Ramsden a reward of £300 for the invention of his machine, and £315 for the machine itself, leaving it, during pleasure, in his possession, on condition that he would divide sextants at 6*s.* and octants at 3*s.* each for other mathematical instrument makers.

Machines of a similar kind, with alterations and improvements, have since been constructed by John Troughton, Edward Troughton, and others, and these are still employed in all instruments which are not large enough, or not sufficiently valuable, to require original dividing.

GRA'DUS, the contraction for *Gradus ad Parnassum* (stairway to Parnassus). Parnassus is the mountain range overhanging Delphi, and was the seat sacred to the deities of poetry and song, as Mount Olympus was for the gods in general. A *gradus* is therefore a system of gradual training in these arts.

In music the title is almost absorbed by the celebrated "Method of the Pianoforte" written by Clementi (1817), containing 100 progressive studies arranged in two books, and to this day the basis of a sound style. Another, and in its time equally valuable, musical *Gradus ad Parnassum* is the manual of counterpoint bearing that title by Fux (1725).

In the art of verse-writing in the classical tongues a dictionary of prosody is necessary, and this is also called a *Gradus ad Parnassum*. Both Greek and Latin are well supplied with such poetical lexicons. The aim of a classical *gradus* is to collect the proper poetical vocabulary, excluding mere dictionary words not found in the best poets, to mark each word with the correct quantity of its syllables, and to give to all important words a short collection of synonyms, though this latter fully carried out is the office of a *Thesaurus*. To these a few quotations are added to show how the word fits into the lines of the poet quoted from. Some works even assist the young poet by providing him with fit epithets to his nouns, as if one suggested "the clashing armour," "the purling brook," &c. The ancient versification depended not upon accent but upon quantity; syllables are either short or long, and every species of metre has its fixed concatenation of short and long syllables. For instance, a hexameter is a verse of six (*hex*) feet, and each foot is either a *spondee* (two long syllables) or a *dactyl* (one long and two short), the varying succession of spondees and dactyls being regulated by a defined though elastic law. Armed with a *gradus* the student constructs his line of words of the appropriate "poetical" diction and of the proper quantity. If he finds his line will not "scan" (*i.e.* cannot be read smoothly in a quantitative sing-song), he must insert fresh words of the same meaning but of correct quantity, instead of those whose syllables disturb the scanning. The work somewhat resembles a Chinese puzzle, to speak irreverently, and instead of the scholars at our great schools spending "ten years learning to make bad Latin verses," as was up till a few years back invariably the case, they now usually devote their energies to something more useful.

GRAE'Æ, THE (Gr. *Graiai*, gray sisters), the sisters of the more famous GORGONS of Greek mythology, were three daughters of Phorkys and Keto. Their names were Deinō (alarm), Pephredō (dread), and Enyō (horror). In order to protect the Gorgons their home was at the only approach to their dwelling, and they were charged to secrecy. Here in perpetual mist they lived, very old, withered, deformed, and decrepit, having but one eye and one tooth between them, which they passed from hand to hand as they were required. Perseus stole their eye and their tooth, and refused to give them back till they had indicated to him the way to the dwelling of the Gorgons and to the nymphs who held the magic appliances he needed for his contest with the latter. No doubt the legend of the terrible Gray Women arose from the dread with which the slow creeping mists were regarded, so often fatal to the mariner among the rockbound isles of Greece.

GRAFFI'TI (literally *scratchings* or *scribbles*) is the Italian name for a peculiar class of ancient inscriptions, scratched centuries ago by boys, common soldiers, &c., with any rough tool to hand to serve as a stylus or writing point, upon the walls of Roman houses. In all the best ruins of the empire such graffiti are found frequently mixed with rudely executed sketches. In Pompeii at the time of the eruption which buried it an election was going on, and it is pitifully amusing now to see on the walls the scrawls from Philippus or another, who "beseeches you to create M. Holconius Priscus duumvir of justice;" elsewhere "Cneius Helvius is worthy of the honour of the duumvirate," or "Pansa is most worthy for duumvir." Several others are named also. In the taverns of Pompeii are amusing pieces of personal chaff among the frequenters. A most interesting branch of this curious study is that of the *graffiti* of the catacombs; pious scribblings on the wall, so fragile and yet so long enduring, preserving through the ages memories of the dead "who died in the Lord," only too often amid the pangs of martyrdom. But the most precious of all *graffiti* is one in the *Collegio Romano* collection of Kircher found in the guard-room of the Palatine, and being in fact the jeer of one of the pagan imperial legionaries some sixteen centuries ago against the faith of his fellow-soldiers who worshipped the Crucified One. He has insultingly put an ass's head upon the figure on the cross. Beneath is the sentence in the fashionable Greek which aristocratic Rome affected, *Alexamenos sebete theôn*, Alexamenos worships his god—misspelt and ungrammatical, and doubly precious for those very reasons. It was discovered by Garucci in 1856. Many of the Pompeian inscriptions are in the ancient Oscan tongue, which had lingered among the common folk as a rustic dialect. These *graffiti* indeed give us much of our knowledge of Oscan.

GRAFFITO is also the name of a very fine method of linear wall decoration used during the Renaissance, and now successfully revived. A coating of pitch being given to the wall, for instance, this is covered with a thin layer of fine plaster. The artist, scraping through the plaster, forms his design in outline by the lustrous pitch which shows out through the spaces cut away from the overlying plaster. Any designs in outline, from conventional patterns to figure subjects, are available. Other colours and compositions as backgrounds are also used. The artist who works for the process of typographic etching also uses a form of graffito.

GRAFTING is an operation by which a portion of one individual of the vegetable kingdom is applied to another which is within certain limits of physiological affinity, so as to form a vital union, and consequently produce a reciprocal growth. Thus a species bearing small and austere fruit may be cut down, and the remaining part grafted with a scion from a tree of which the fruit is large and delicious; and being nourished, but not changed in any essential character, this scion will form a tree, ultimately producing fruit similar in every respect, all other circumstances being the same, to that of the tree from which it was taken. The shoots of any particular variety may be cut into many hundred pieces, if sufficiently numerous, and by grafting each of them can be made to possess all the properties of an individual tree in the course of one season. In the case of cultivated fruits, as well as in many varieties of ornamental plants, multiplication by seeds is precarious; and with regard to *hybrids* it is impracticable, at least no assurance can be had of a reproduction of the same variety; on the contrary, a disposition is generally manifested to return to the natural wild state of the species. Grafting is in some instances the only means, and in many it is the most eligible, of preventing this. By it the peculiar richness of the fruit, or the delicate tint of the flower which we especially prefer and admire, can be perpetuated in an almost infinite series of individuals, each being the result of augmentation of the comparatively small original portion —this portion being placed in favourable circumstances for receiving an abundant supply of new and proper matter, on which it exercises its organizing powers and effects a

perfect assimilation, which causes a similar development of leaves, flowers, and fruit. Propagation by cuttings, it is true, will equally continue the variety unchanged; but that process in numerous instances is slow; in others success is not attainable to any considerable extent.

The limits within which grafting may be effected extend to species and varieties of the same genus, or at all events are confined within the same natural order.

Pears may be grafted not only on other pears, but also on the quince (which is very frequently done) and on the medlar, whitethorn, or mountain ash. Peaches are budded either on the almond, or more frequently on the plum, their own roots not being suited to the cold soil of this country. In these cases, although the leaves and fruit of the peach and the plum, the pear and the mountain ash, have a very different appearance, yet botanists have determined that the stock and the scion belong to the same natural order. But mere affinity does not account for all the circumstances, for it is difficult to graft the pear on the apple, or the apple on the pear.

The effects produced in grafting by the scion on the stock, and the stock on the scion, are not always apparent, but there is no doubt that the one induces some physiological change in the other. A well-known instance occurs in the laburnum called by gardeners *Cytisus Adami*. This originated from grafting a laburnum with purple flowers on erect shoots (*Cytisus purpureus*) with the common laburnum (*Cytisus Laburnum*), which has yellow flowers on pendulous shoots. The result is a tree producing both kinds of flowers, as well as intermediate forms. The pear is grafted on quince or whitethorn stocks, for these being of slower growth than the pear, the sap does not flow so readily, and the consequence is that the pear does not run to wood and leaf so much, but produces more fruit, and at an earlier age. "Some authors have denied that grafting causes even the slightest difference in the scion, but there is sufficient evidence that the fruit is sometimes slightly affected in size and flavour, the leaves in duration, and the flowers in appearance" (Darwin, "Animals and Plants under Domestication," vol. ii. 278).

The methods of grafting are of great variety. M. Thouin ("Monographie des Greffes") has enumerated forty-three modes of grafting, thirty-nine of inarching, and twenty-eight of budding. Many of these are, however, more curious than useful, and not worth being detailed. It will be better to explain the principle on which all modes of successful practice must depend, either as regards grafting, budding, or inarching.

It is well known that the bud of a plant has the power of becoming a distinct individual, if separated from the parent and placed in circumstances sufficiently favourable for its future development. But no development can take place unless the portion abstracted from any plant contains either a bud or the perfectly formed rudiments of one. Hence the portion intended to be propagated must contain a bud or buds. The diametrical increase of dicotyledonous plants proceeds outwardly in consequence of the formation of new layers of sap-wood, interwoven into the peculiar texture of the tree by extensions of the medullary rays. The sap-wood is interposed between the inner bark and the heart-wood, with both of which it is in vital or organized union. The greater part of the heart-wood of a tree may be bored out, and though made a hollow cylinder, it will still continue to increase. The outer bark may be removed, and a new one will gradually be formed, but if the sap-wood be entirely destroyed death will be the consequence.

It appears, therefore, that buds with some portion of sap-wood are the parts essentially necessary for propagation, for although the heart-wood and bark be organized, yet they are but passively so, and have not the power of extending organization to new matter when they are deprived of the media of buds and sap-wood. Keeping, therefore, the importance of the latter in view, the best mode of operation is that whereby the greatest possible extent of the sap-wood of the stock and graft is brought into exact contact, without making too extensive a wound. If the sections of sap-wood can be made to coincide in every point, the result of the operation will be the most perfect that can be obtained.

The modes of grafting most generally practised are whip, cleft, saddle, and crown grafting. Of these whip-grafting is by far the commonest, and is performed as follows:—The stock is cut over, sloping above a smooth and straight part. The end of the scion is cut sloping and thin towards the lower part. Then, on the same side of the stock as that of the lowest part of the slope made in cutting off its top, a slice is cut clean off, in length equal to that of the cut part of the scion, and in breadth so as to expose as much of the wood of the stock as will equal that seen in the slanting section of the scion. Both sections should be smooth and plain, and as regards the sap-wood, they should be the exact counterparts of each other; or if this cannot generally be the case the coincidence should be as exact as

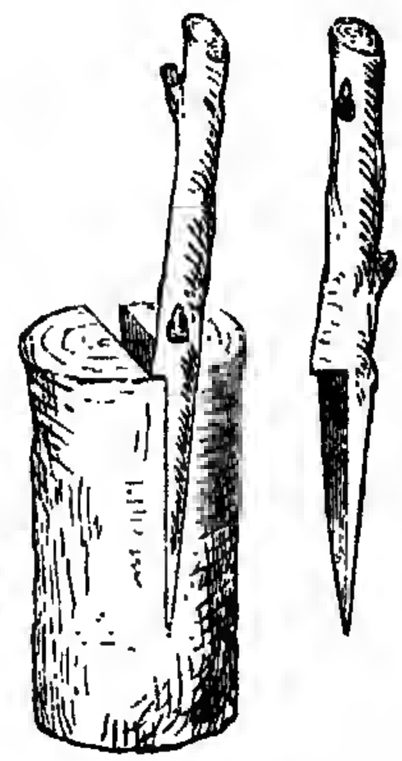


Fig. 1.—Cleft-grafting.

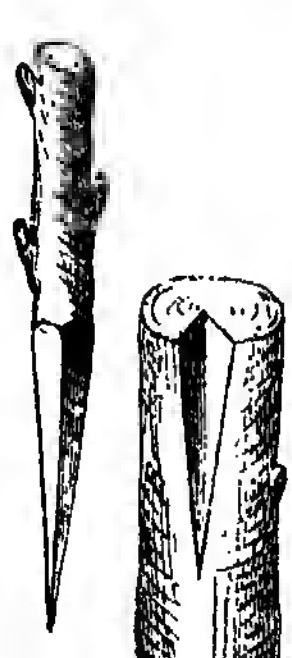


Fig. 2.—Triangular Notch-grafting.

Fig. 3.—Saddle-grafting.

can be on one side at least. A thin wedge-shaped tongue is made very near the upper part of the slope in the scion, and a corresponding nick in the stock to receive it. The top part of the scion is shortened to two or at most three buds, and fitted to the stock, to which it is tied with a strip of pliable matting; and the parts so united are then covered with grafting-clay or some other composition, which remains till the graft has pushed, or as long as there is no danger of the matting used as a ligature cutting or galling the parts when they begin to grow and to have an enlarged circumference. After the first loosening

it is often advisable to apply slightly a fresh bandage immediately; and in some cases a little clay or composition may be put round, should the union appear too tender to endure exposure to the vicissitudes of the weather.

Cleft-grafting is performed by splitting the stock diametrically across the top, which should be cut horizontally, and then nicely inserting into the cleft a scion cut like a wedge. Fig. 1 represents cleft-grafting, and fig. 2 another form of it. In saddle-grafting the end of the stock (*a* in fig. 3) is cut into the form of a wedge, and the scion made to fit over it like a saddle (*b*). Crown-grafting is used for large stocks or limbs with thick bark; these are cut off at right angles, the bark is raised, and the end of the scion, properly thinned as if for whip-grafting, but without the tongue, is inserted. Three or four scions may thus be grafted in the same stock. Herbaceous plants with firm stems, as dahlias, are sometimes grafted.

Cuttings intended for scions should be taken from the trees before the movement of the sap commences in spring,

Fig. 4.—Inarching.

and put in moderately moist earth or sand, and out of the sun's rays. If the stocks be cut down at the same time it will be so much the better; any large limbs of trees which it may be found necessary to graft should by all means be cut in before vegetation becomes active, otherwise extravasation takes place, and canker is in consequence induced.

The clay used in grafting may be made from any smooth clay, or adhesive clayey yellow loam, or brick-earth, mixed with one-third, or, according to some, one-half of cow-dung free from litter, except that of hay, and if it contain none of the latter some fine hay must be beaten up with the mixture. The hay answers the same purpose as hair in plaster.

A more convenient composition is that known as *mastic l'homme Lefort*, first made in France. It somewhat resembles half-melted gutta-percha, and has an agreeable perfume. Kept in a box it remains moist, but quickly dries when applied to the graft. It can be spread with a flat piece of wood, and is easily removed after the graft has taken.

Inarching is a species of grafting the success of which depends on the principles above explained. It is sometimes called grafting by approach, because in performing the operation the branches or stems of two contiguously growing plants are made to approach and then unite; and this union is effected on the same principles as that of whip-grafting.

GRAHAM, SIR JAMES ROBERT GEORGE, a distinguished statesman, was born 1st June, 1792, and was educated at Westminster School and Queen's College, Cambridge. He became private secretary to Lord Montgomerie, the British minister in Sicily, and afterwards to Lord William Bentinck, the commander-in-chief in the Mediterranean. He was elected member of Parliament for Hull in 1818, but lost his seat at the next election. He again entered Parliament in 1826 for Carlisle, and was a warm supporter of Catholic emancipation. In 1830 he held a seat in the cabinet as first lord of the admiralty. He was a great favourite with the extreme Liberal party, and helped to frame the Reform Bill of 1832. But in 1834 he left the government on the Irish Church question, and gradually veered round in his opinions till in 1841 he became secretary of state for the home department in Sir Robert Peel's government. In 1844 he became unpopular by ordering the letters of Mazzini to be opened by the post-office authorities and the Austrian minister to be informed of the contents. He assisted in carrying the Corn-law Repeal Bill, and resigned office at the same time as Sir Robert Peel, on whose death he became leader of the Peelite party, and led the opposition to the Ecclesiastical Titles Bill. He took the post of first lord of the admiralty under Lord Aberdeen in 1852, which he held till 1855. From that time till his death on 25th October, 1861, he was a supporter of Lord Palmerston, but declined office in both of that minister's administrations. Notwithstanding his political inconsistency, he was one of the most eminent and respected statesmen of modern times.

GRAHAM, JOHN (VISCOUNT DUNDEE), commonly called *Claverhouse*, was born in 1643. He is said to have studied at St. Andrews, and to have made some proficiency in mathematics. Like many of the younger sons of the Scottish gentry, Graham became a soldier of fortune in the continental wars, first in the French, and then in the Dutch service; in the last he obtained considerable distinction. He returned to Scotland in 1677, and obtained a captain's commission in one of the troops of horse employed in enforcing obedience to the penal laws against nonconformists in Scotland. He was defeated by the Covenanters at Drumclog, 1st June, 1679, and compelled to flee for his life. At the subsequent battle of Bothwell Bridge he commanded the cavalry. In 1688 he was raised to the peerage by the title of Viscount Dundee and Lord Graham of Claverhouse. While the Convention Parliament was sitting in Scotland arranging the Revolution settlement, he put himself at the head of the Highland and Irish Jacobites, with whom, on the 17th of June, 1689, he completely defeated Mackay at the Pass of Killiecrankie, where he was killed by a random shot. To one party in Scotland Graham was the very embodiment of cruelty and inhumanity, while by his followers and his own party he was worshipped as a perfect hero. However this may be, it is clear that he was not more cruel than the law he was appointed to enforce, nor than his superiors, who were among the worst of the many cruel rulers Scotland has suffered under.

GRAHAM'S DYKE is the local name of the wall of Lollius Urbicus (A.D. 140), general of the Emperor

Antoninus Pius, sometimes therefore called the "Wall of Antoninus," a considerable earthen rampart running along the line of the detached forts which Agricola had planted sixty years before between the friths of Clyde and Forth to serve as a defence against the northern barbarians, the Picts and Scots. These forts were now connected by the dyke of Urbicus. The idea was a good one, but it was thought of too late, and but a few years elapsed before the Caledonians swarmed across it in every part of its length. Many traces of it still remain. The origin of the name Graham's Dyke is not known.

GRAHAM'S TOWN, the capital town of the county of Albany, Cape Colony, is situated in a basin among the eastern spurs of the Zuurberg range, near the source of the Kauri River, 25 miles from the sea, direct distance. It is a well-built town with wide streets, and is well supplied with water from springs in the hills. The site is 1760 feet above the sea, and from the free access of the sea air, its height, the declivity of the ground and gravelly subsoil, it is an extremely healthy place. Winter is scarcely known; the Mozambique current greatly tempers the climate of the entire coast. A suburban village has been formed of late years on the top of the ridge, 2100 feet above the sea, where residence is peculiarly suitable for certain invalids. The whole neighbourhood of the city presents varied and beautiful scenery. The inhabitants are mostly English settlers. There are places of worship for the various religious sects, and numerous important institutions, including St. Andrew's College, a Kaffir college, a museum and natural history society, public library and reading rooms, law courts, barracks, military and other hospitals, &c. The gardens produce all the English and many subtropical fruits; and in the vicinity are found rich iron ores, ochre beds, and beds of China clay. There are brass and iron foundries, steam and lathe mills, tanneries, soap and candle works, coach and waggon building establishments; and a considerable traffic is carried on chiefly through Port Albert, 40 miles distant. The river Kauri here enters the sea; it is a perennial stream, and costly works have been constructed so as to deepen it at the mouth and make a safe harbour and roadstead; vessels drawing 10 feet of water can enter the harbour. There are steam-tugs for service of larger vessels lying in the roadstead. The wind here is almost always either up or down the coast, so that vessels can at once put to sea for safety. Graham's Town is considered the metropolis of the eastern districts of Cape Colony. The population is 10,000.

GRAIL, THE HOLY. See GRAAL.

GRAIN (Lat. *granum*, a seed), an old measure of weight, the smallest of those in use. It is of about the weight of a seed of wheat corn, and must therefore be considered rather as a theoretical aliquot part of a larger weight than as itself a proper standard of weight. By a statute passed in the reign of Edward III. in 1266, it was enacted that 32 grains of wheat, taken out of the middle of the ear and well dried, should weigh a pennyweight, of which 20 should make an ounce, of which 12 should make a pound. The "penny" here spoken of was a silver coin; and the old statute begins, "An English penny, now the largest coin in England, which is called a sterling, round and without clipping, shall weigh 32 grains of wheat," &c. Consequently the pound (troy) of this period consisted of 7680 grains, whereas that afterwards in use had only 5760. The reason was, that it became usual to divide the same pennyweight into 24 instead of 32 grains.

The weight of one grain is obtained, for practical purposes, without difficulty, by weighing a thin plate of metal of uniform thickness, and cutting out by measurement such a proportion of the whole plate as should give one grain. But a much better plan is to draw a given weight of ductile metal into very thin wire, and to cut from the wire that length which is the same proportion of the whole length as a grain is of the whole weight. In this way pieces of wire are obtained for chemical purposes which weigh only the thousandth part of a grain; and even less weights might be obtained if it were necessary.

GRAINS OF PARADISE are hot, acrid, aromatic seeds, obtained from the west coast of Africa, and used for medicinal and other purposes as stomachic and cordial stimulants. They are produced by the *Amomum Melagueta* and *Amomum Grana-Paradisi.* The natives use these seeds as a condiment to season their food; but in Europe they are chiefly employed to adulterate spirituous and fermented liquors, by increasing the pungency and imparting an apparent strength. By 56 Geo. III. c. 58 brewers and publicans are prohibited from having grains of paradise in their possession, and any beer or ale found containing it may be forfeited, and the brewer fined £200 for the adulteration. *Amomum Melagueta* is a herbaceous seed-like plant, from 3 to 5 feet in height. The delicate wax-like flower is of a pale purple colour, and reaches scarcely an inch above ground. It is succeeded by a smooth scarlet ovoid fruit, 3 or 4 inches in length. The plant is cultivated in Demerara. See AMOMUM.

GRAKLE is the name given to some species of birds belonging to the family Sturnidæ or starlings. The genus Gracula, to which the name properly belongs, is nearly allied to the true starlings (Sturnus) and pastors (Pastor). The typical species is the Jungle Grakle (*Gracula religiosa*), an inhabitant of India and Ceylon; it is about 10 inches in length, and of a brilliant black colour, with a violet and greenish gloss on some parts. Each of the seven last quills of the wings has a white spot on its outer margin, and behind each eye there is a naked membrane, of a rich yellow colour, which nearly meets that of the opposite side on the occiput. This bird is met with in the lofty jungle, where it does not appear to be either common or greatly distributed; it is generally seen in small parties of four or five, frequenting the tops of the highest trees, and feeding on fruits and berries. It has a fine and varied song, for the sake of which it is often kept in confinement; it is also said to surpass all other birds in its power of imitating the human speech.

The name grakle is also given to an American group of birds forming the subfamily Quiscalinæ, of the family Icteridæ, and finding its nearest allies in the cow-bird (Molothrus) and the Baltimore oriole (Icterus). To this subfamily the name Boatbill is also given, from the curious shape of the tail, which is long and graduated, with the sides curved upwards. The bill is long and stout, and the inside of the upper mandible is furnished with a sharp process, resembling the broken blade of a penknife, which is no doubt useful to the bird in breaking up its food. The Purple Grakle (*Quiscalus versicolor*) may serve as an example of this group. This bird, which is also known as the crow blackbird, is about 12 inches in length, and of a black colour, exhibiting blue, violet, coppery, and green tints on some parts of its plumage in certain lights. It is migratory in its habits, visiting the United States of North America during the summer, and retiring before the inclement season to the warmer parts of the American continent and islands. Its depredations on the corn-fields of the farmers are too great to render it a very welcome visitor; when the ears are in the milky state the havoc it makes is enormous. Nevertheless, at their first arrival, these birds destroy immense numbers of caterpillars and grubs. They roost on the cedars and pine trees, and build their nests on the highest branches of these. The nest is composed of mud, mixed with grass and roots, and lined with fine bents and hair. The eggs are about five in number, of a bluish-olive colour, spotted and streaked with black and dark-brown.

GRALLÆ is an order of BIRDS, usually called Wading Birds, from the habits of the greater number of them. The characters of this order may be shortly given as follows:—The feet are adapted for walking, and furnished with three distinct long toes, usually united by a small membrane at the base, and sometimes bordered with membranous lobes, but not completely united, as in the swimming birds; the legs, and especially the tarsi, are always rather long, and sometimes much elongated; and the naked scaly skin of the feet is almost always continued for a greater or less distance above the articulation of the tarsus with the tibia. The whole of the naked skin is usually reticulated. The posterior toe is sometimes entirely wanting, and generally but little developed. It varies also in its position, being either placed on the same plane as the anterior toes, or slightly elevated on the back of the tarsus. To compensate for the great elevation of the legs, the neck is almost always considerably elongated, and as a general rule the bill is likewise rather long. By this means the bird, when stalking along upon the ground, or wading in shallow water, is enabled to pick up worms, mollusca, and insects, or to strike with ease and rapidity at passing fishes. The wings are generally well developed and furnished with long quills. The body is generally thin and compressed.

In habits, as in form, the Grallæ present many differences. They are generally very active, running and flying with equal ease and celerity; nearly all can swim well. Some frequent marshy places and the borders of water, in which they seek their food, while others haunt dry sandy heaths and similar situations. Even among the aquatic species a great diversity obtains—some wading in the shallow waters by means of their long and slender legs; others, which are provided with very elongated toes, running over the floating leaves of aquatic plants; others, again, some of which have their toes bordered with membranous lobes, swimming about and diving with the greatest ease. The food of the greater part consists of fish, worms, &c.; a few feed on grains. In most cases the eggs are laid on the bare ground; the nests constructed in a few cases are very simple. Most of the Grallæ are birds of passage. In the Plates prefixed to this volume are figured some of the typical representatives of the order. The first family to be noticed is Ciconiidæ (the storks), falling into two suborders, Ciconiinæ (the true storks) and Scopinæ (the umbres). The first of these subfamilies contains the white stork (fig. 1), the adjutant, the jabiru (fig. 2), the openbill, and the wood-ibis. Scopinæ contains only two birds, the umbre (fig. 3) and the shoebill (Balæniceps). The Plataleidæ may be also divided into two subfamilies, Plataleinæ, the spoonbills (fig. 4), and Ibidinæ, the ibises, a species of which, the sacred ibis of the Egyptians, is well-known. The Ardeidæ (or herons) contains many well-known birds, among which may be mentioned the true herons (fig. 5), the egrets, bittern (fig. 6), boatbill and night-heron. The Charadriidæ (or plovers) is a large family, including the golden plover (fig. 7), dotterel, gray plover, sand-plover, lapwing, turnstone, oyster-catcher (fig. 9), pratincole (fig. 8), courser, and thick-knee or stone-curlew. The two last-named birds connect the plovers with the bustards (Otididæ), in which family they are sometimes placed. The Gruidæ (or cranes) may be divided into three subfamilies, the Gruinæ (true cranes), the kagus (Rhinochetinæ), and the sun-bitterns (Eurypinæ). The trumpeters (Psophiidæ) are intermediate between the cranes and bustards; a well-known species is the Agami. The snipe family (Scolopacidæ) is a large and widely distributed family. Among its members are the snipe (fig. 10), woodcock, sandpipers, redshank, ruff, godwit, curlew, stilt, and avocet. Another large family is Rallidæ (the rails), conspicuous for the shortness of their wings. Of this family the best known are the true rails (fig. 11) corncrake, water-hen, and coot. The jacanas (fig. 12) form a separate family, Parridæ. The screamers (fig. 13) are now usually referred to the Anseres.

GRAM is a general name in India for the chick-pea [see CICER] and for various kinds of pulse, which are produced from different species of the Phaseolus and Dolichos, and distinguished by colour; thus the *Dolichos uniflorus* is known as the horse-gram, and so on. From the large percentage of gluten the gram is considered when roasted to be more capable of sustaining life, in proportion to its weight, than any other species of food. For this reason it is selected by travellers about to cross the desert, when other food, on account of bulkiness, might be inconvenient.

GRAMMAR (Gr. *gramma*, a letter) is the science of speech. Language is articulated sound. Pulses of air, variously modified as they pass through the vocal organs, supply the elements of speech. Between these sounds and the ideas entertained in the mind a correspondence is (in some way) established, so that the one suggests the other. Speech is a product of social life, the power of interchanging thought and feeling by the expression of the impressions of the mind. Words possess (1) *form*, represented in speaking by *sounds* and in writing by *letters*; (2) *significance*, or meaning either indicated or suggested; and (3) *function*, or influence exercised upon or relation borne to one another. Groups of sounds form words; words, significantly and appropriately used, constitute speech.

Grammar collects and arranges the main facts of language, analyzes and classifies words, details and illustrates their peculiarities, and supplies rules for their proper employment in speaking and writing. It comprises (1) a knowledge of words as the phonetic symbols of thought; (2) a doctrine of the functions of words in the expression of ideas; and (3) a statement of the principles which regulate the communication of thought from mind to mind.

Grammar may be treated of in various ways. It is—1, *philosophical*, when it analyzes and explains the facts of language and reduces the complexity of its phenomena to the simplicity of a clearly understood organic unity, the principles of whose structure it sets forth; 2, *comparative*, when, seeking a common basis for research, it surveys the various languages spoken or written by mankind, shows how far they exhibit the same general character or any similarity of operation, investigates the causes of their similarities and differences, and provides a theory which explains their facts and guides us in the study of them; 3, *historical*, when it examines the sources, affinities, changes, and progress of human speech, and gives an account of the causes and effects of the growth and decay of words and forms; and 4, *practical*, when it arranges, summarizes, and explains the principles and peculiarities of the languages made use of in any particular country or by any special race. See also LANGUAGE.

The student of the history of speech finds some languages exceedingly clumsy and others extraordinarily precise; some so rugged that they might "splinter the teeth of a crocodile," others so smooth that they seem to consist of an intricately interwoven melody of sounds. Grammar examines, tests, and explains the reasons that may be found for the facts of language, and endeavours to discover the principles which govern its development as the instrument of thought. Protagoras, the sophist of Abdera (444 B.C.), employed great ingenuity in gaining and giving a knowledge of discourse as a fine art. To the grammar of Greece he supplied some acute observations on the genders of nouns and the moods of verbs. Prodicus of Ceos collected the finest phrases of the ancients as models, and taught most ingeniously the distinctions of synonyms. Socrates trained men to aim at securing an exact correspondence between their ideas and their words, enforced

the practice of careful definition, and led men's thoughts to the principles of expression. Plato, the earliest scientific grammarian, first pointed out the nature of the subject and the predicate. In "Philebus" he tells us how *Theuth* in "the limitless infinite of vocal speech" discerned "letters (vowels and consonants), the proper combination of which gave rise to grammar." His "Cratylus," whether we regard it as serious or playful, shows an endeavour to philosophize on etymology, and to find out a ground in reason for the use of nouns. Aristotle distinguished between nouns and verbs, divided nouns into simple and complex, and pointed out the use of their cases. He refers also to conjunctions, prepositions, and adverbs, and to the nature and functions of pronouns. The Stoics, too, though rather in relation to logic than to grammar, drew attention to the differing functions and characteristics of words. Alexandria, however, was the birthplace of specific grammatical instruction. Zenodotus pointed out the distinction between singular, plural, and dual, and between articles and pronouns. Aristarchus of Samothrace, the typical critic of classical times, taught the nature of prepositions and the functions of participles. The name of Zoilus (390 B.C.) has become a byword for a pedantic grammatist. Crates of Mellos (159 B.C.) composed the first formal treatise on general grammar. By this time grammar had been arranged into two parts—(1) *exegetics*, which explained the nature and meaning of words and phrases; and (2) *method*, which set forth the principles and prescribed the rules of speech. Apollonius of Alexandria, pupil of Didymus and teacher of Apion, is called by Priscian the prince of grammarians. From Alexandria, about 80 B.C. Dionysius the Thracian transferred the teaching of grammar to Rome. He defined the eight parts of speech, and gave the "accidence" very much the form it still bears. His work became the model of after ages. His definitions, declension-tables, and paradigms stereotyped themselves on men's thoughts, and grammar was brought into the bondage, not of his spirit, but his forms. The worth of his ideal was incalculable. He based grammar on an induction of facts, and thence deduced his rules. His successors reduced his science into burdensome tradition. Apollonius Dyscolus (the Ill-tempered) emulated him. He produced upwards of thirty treatises, of which four only remain—those on syntax, pronouns, conjunctions, and adverbs. Even after the age of Constantine Greek continued to be the language of letters, and the *grammatici* were the professional teachers of the arts of composition. But the Romans, desirous of making their language a rival in copiousness, excellence, and refinement to that of the Hellenic races, entered earnestly on the duty of culturing their forms of speech. Crates had stirred them to this. Gnipho, the teacher of Cicero, wrote a treatise on language. Various researches in grammar were widely and wisely made. Verrius Flaccus taught composition in the palace of Augustus. Under the Cæsars many studied grace of style and accuracy of expression. The "Noctes Atticæ" of Gellius (150 A.D.) contain many valuable grammatical remarks. Ælius Donatus, in his "De Octo partibus Orationis," supplied the most popular text-book of the fourth century. Priscian's "Institutiones Grammaticæ" (440 A.D.) took (and even yet holds) a high place among Latin grammars. Many of the discussions between the Nominalists and the Realists were, in fact, grammatical, and the Schoolmen, being authoritative teachers of thinking and speaking, "have really," as Coleridge said, "made the languages of Europe what they now are." By them the grammar and terminology of Latin were impressed for centuries upon the languages of Europe, and thus for a time the native folk-speech was prevented from asserting to itself freedom of form and growth. After the fall of the Roman Empire nothing could prevent the break-up of the Latin language into what Diez calls the *Romanic* tongues. Speech, set free from Roman despotism, developed into nationality. Scholarship still, however, strove to bind all speech in the traditional grammar of the antique time. In the age of Charlemagne, Alcuin rearranged the grammar of Cassiodorus and Capella; in the stir of the revival of letters Emmanuel Crysolorus (1395) was the first great Florentine teacher of Greek; Laurentius Valla, the ablest linguist in the fifteenth century, expounded in his "Elegantiæ Latini Sermonis" the syntax and synonymy of the Roman classics; and even Reuchlin, who made the earliest attempt, in his "Rudimenta Linguæ Hebricæ," to bring the speech of Israel into grammatical form, arranged it on the Roman model. Dante, Boccaccio, and Petrarch, besides being stimulators of linguistic studies, favoured the use and progress of the vernacular of their age. The Humanists of the Reformation—who encouraged scholastic grammar while they eschewed scholastic logic—moulded their grammar on the forms of Dionysius. Conrad Gesner, with prodigious erudition, in his "Mithridates" (1555), arranged many languages according to their origin and analogies, and so laid the foundation of comparative grammar. Two centuries and a half thereafter Adelung, in a work bearing the same title, advocated, pursued, and extended "the general study of languages." Sir William Jones had in 1784 pointed out the vast mines of information on the relations and affinities of languages which the study of Sanskrit affords. Franz Bopp, in his "Comparative Grammar," wrought out that hint. J. L. Grimm in 1819 created, by his "Deutsche Grammatik," historical grammar—a branch of study which has since acquired an independent existence. Philology has by its aid become scientific.

Classical grammar has been pursued on the old lines and into various developments by numerous scholars in all lands, from Varro to Zumpt, Grotefend, Donaldson, Madvig, Key, &c.; and the study of folk-speech has led to the production of many special grammars, intended to teach the principles and formulate the practice of the chief modern languages now in use.

Grammar is now so wide in its range and varied in its matter that it requires to be distributed among special investigators, who take it up in some such division as follows:—1. *Glossology* (Gr. *glossa*, the tongue), a knowledge of all that relates to *spoken* language, including (1) phonetics, (2) orthoepy, (3) elocution, (4) oratory. 2. *Graphics* or grammatology, an exposition of all that concerns *written* language, comprising (1) alphabetization, (2) orthography, (3) etymology, (4) syntax, (5) composition, (6) prosody. 3. *Philology*, a systematic view of the facts of language and the lessons they teach us regarding the origin, development, progress, differences, resemblances, and fundamental principles of speech. This comprehends (1) the history, (2) the changes, (3) the meanings, and (4) the affinities of words; and it sometimes extends its aim so far as to include everything relating to language, whether in its vernacular or literary forms.

The modern ideal of grammar as the science of speech has of late years led to its having been even more definitely formulated into specialized departments, thus:—1. *Phonology* or phonetics, an analysis of significant sounds, resulting in (1) alphabetism, or a classified arrangement of all the elementary sounds employed in any language; (2) orthoepy, the accurate pronunciation of these sounds, singly or in combination; (3) elocution, the correct conveyance by significant sounds of speech. 2. *Graphics*, the representation of sounds, (1) by letters (writing); (2) by the positions of the fingers (dactylology), as used by the deaf and dumb; (3) by dots (raphigraphy), as used by the blind, or in telegraphy, &c.; (4) by hieratic or hieroglyphic writing, and (5) by pictorialism—representative, indicative, suggestive—as in Chinese, &c. 3. *Orthography*, an exposition of the laws by which sounds are so represented by letters as to form words, and the practical art on which

spelling and writing, according to *usage*, the *jus et norma loquendi*, depend. 4. *Lexicology* or lexicography, a knowledge of the words of a language, their meanings and their uses, whether (1) vernacular, (2) literary, (3) provincial, (4) dialectical, (5) technical, (6) radical, (7) derivative, (8) obsolescent, &c. A sub-branch of this has recently been made or specialized, as *dialectology*. 5. *Etymology*, a correct knowledge of the (most remotely known) original or germ-form of words allied in outward appearances, inner structure, or meaning. This is sometimes called *derivation* or *radicarianism* (Lat. *radix*, a root), and then includes a knowledge of the facts and laws of the formation and growth of words, the means used by the combination of primitive roots (or root-stems with modifying particles) to produce those varying compounds which add so much to the copiousness of the vocabulary of modern languages. It embraces also the subsidiary arts of (1) classification, *i.e.* the arrangement of the words of a language within itself according to their functions as parts of speech; and (2) parsing, *i.e.* the pointing out of these parts. 6. *Inflection*, an explanation of the changes made on or in words to indicate or suggest their several relations. In nouns and pronouns these changes constitute *declensions*, in tives (and some adverbs) *comparison*, and in verbs *conjugation*, which are usually exhibited in *paradigms* (Gr. *deiknumi*, to show) or tabular models. 7. *Syntax* (Gr. *taxis*, order), the laws which regulate the arrangement of words in sentences, whence result (1) composition, the art of expressing thought in proper words correctly interrelated; (2) style, the adaptation of the literary form, choice and texture of words, &c., to the nature of the thought to be expressed. This fit and effective arrangement of expression is aided by the arts of (*a*) analysis, *i.e.* the resolving of compositions into their component parts—paragraphs, sentences, clauses, phrases, and words; (*b*) synthesis, *i.e.* the organic collocation of words, phrases, clauses, sentences, and paragraphs, so as to form an artistic literary whole. 8. *Synonymology*, the tracing of the signification of words to show (1) how unlike words come, by assimilation, to have a similarity of meaning; and (2) how like words—words having the same or a similar origin—acquire, by dissimilation, special variations of meaning. 9. *Prosody*, the means of bringing out the special beauties of thought by expressing them in words of a sympathetic kind. Its parts are, (1) melody, suitability of sound to sense; (2) harmony, consistency of parts; (3) rhythm, the pleasant attunement of composition; (4) metre, the arrangement of speech into measured forms; (5) rhyme, the assonance of line-endings one with another; (6) versification, the metrical and rhythmical arrangement of lines singly or in groups. Some of the last-named topics belong, strictly speaking, to RHETORIC.

After the fall of the Western Empire, the decline of scholasticism, and the aggregation of the inhabitants of Europe into new nations, the Romance (or as they are more correctly designated by Diez, the Romanic) languages took form, and from these the chief modern tongues of the Continent are derived. It is impossible to fix the precise date at which written and spoken Latin, with its interlocking inflections and its compact syntax, ceased to be intelligible to the common people, and were replaced by languages rich and flexible enough for ordinary use, and sufficiently polished for literary purposes. Sismondi supplies the following approximations:—Provençal, 887; French, 948; Castilian, 1065; Portuguese, 1112; and Italian, 1154. Though, etymologically and historically, German exists in the translation of the Bible by Ulfilas, 360 A.D., it was nearly a thousand years after that before its grammatical structure was confirmed. These languages—though controlled by the habits and usages of the influential—had not then any formulated grammar. A Provençal grammar of the twelfth century by Raymond Vidal is still extant; Jacques du Bois (Sylvius), about 1520, was the earliest French writer on grammar. Ten years later John Palsgrave, an Englishman, published in English his "Esclaircissement de la Langue Françoyse." In 1582 Robert Stephens' "Grammatica Gallica" was issued; J. Garnier's "Institutio Gallicæ Linguæ" came a few years later, and by the Port Royal "Grammaire Générale et Raisonnée," by Lancelot, Arnauld, and Sacy, the modern grammar of the French language was put upon a just and solid basis, 1636. Dijona Ben Ganah and Malek Gemeleddin in the thirteenth century are noted as the most admirable grammarians of Spain. S. des Brosses (1523–1600) subsequently took a higher place. Pedro Joze de Figueiredo's "Arte de Grammatica Portugueza" (1799) placed the language of Portugal definitely among those capable of being grammatically taught. Fortunio is the earliest name given in the annals of Italian grammar. His work was followed in 1521 by Liburnios' "Volgari Eleganzie." This was eclipsed in 1525 by Pietro Bembo's "Prose." Benedetto Buomattei, however, by his "Della Lingua Toscana" proved himself to be the best grammarian of his age. After Gesner's "Mithridates" German philology took up more zealously the national speech, and ultimately J. C. Gottsched's German grammar (1730), unscientific and pedantic though it is, took the lead of all previous endeavours to purify the f… speech and fix its rule. By the literary academy of which Spiegel, Kornhoort, and Dousa were members, the first Dutch grammar was issued in 1584. In the same year William Bullokar published "A Bref Grammar for English," which in the preface he asserts is "the first Grammar for English that ever was, except my Booke at Large." This reference is to proposals for an "amendment of orthographie for English speech" which he had issued in 1580. Alexander Hume, who became head master of the High School of Edinburgh in 1606, after having spent the years 1580–96 in England, wrote "Of the Orthographie and Congruitie of the Britaine Tongue" about 1617, and dedicated it to James I., who had expressed his intention to "cause the universities make an English grammar." Among the posthumous writings of Ben Jonson there was found "The English Grammar made by Ben Jonson for the benefit of all strangers out of his observations of the English language now spoken and in use." It was published in 1640. John Wallis, D.D., in 1653 issued an English grammar in Latin. William Walker, B.D., Isaac Newton's teacher, in "A Treatise on English Particles," strove through Latin to improve English. Richard Johnson, of Nottingham, in his "Grammatical Commentaries" (1706), proposed to provide "an apparatus for a new national grammar." In 1711 "A Grammar of the English Tongue"—supposed to have been the production of Steele and Addison—was published by John Brightland. Bishop Lowth in 1758 issued his "Short Introduction to English Grammar," founded to some extent on Harris' "Hermes: a Philosophical Inquiry concerning Universal Grammar" (1751). Dr. Johnson in his dictionary (1755) says, "I found our speech copious without order and energetic without rules; wherever I turned my view there was perplexity to be disentangled and confusion to be regulated." In 1786 Horne Tooke issued his "Diversions of Purley," and in 1795 Lindley Murray produced his "English Grammar," which soon superseded almost every other. Since then thousands of compendiums of grammar have been issued in Great Britain, America, and the colonies. Of late, however, a new tendency has manifested itself in regard to grammar. Among the typical works on these new views we may note Mätzner's "Englische Grammatik," Abbott's "Shakspearian Grammar," the various writings of Latham, Skeat, Ellis, Furnivall, Sweet, Morris, Schmidt, Fleay, &c.

Instead of holding to the antique classical models and

praxes, the desire has been long felt to regard grammar as an inductive science of expression made practically available for the regulation of the use of language in everyday life, (1) by the examination, authentication, arrangement, and classification of facts; (2) by supplying the reason (real or hypothetical) which explains these facts to the mind; (3) by generalizing these reasons into (theoretically satisfactory) scientific expression, and (4) by placing these carefully and plainly before the student of language. In this grammatical method, experience as an external impressing force supplies us with *nouns*, *i.e.* names of things, and *adjectives*, *i.e.* names of the *qualities* of things; while experience felt (1) as an impressed power and (2) as a forth-going energy, gives occasion to the *verb* as passive or active. The *relations* of things call out *prepositions*; of thought, *conjunctions*; while the interrelations of thoughts and things give us *adverbs*. Speech as a unit, which is on the one side impression and on the other expression—t reverse and the obverse, which become *converse*—requires a specific sign for the *experiencer*, and this originates the *pronoun*. The indefinite *one*—which when made definite becomes *I*—is the *first* personal pronoun, as indicating the one in whom speech is evoked and uttered to a *second* person (*thou*) regarding the experience felt as the *third* person *he*, *she*, *it*. The pronoun is the sign of personal existence; but as the analogy of personality permeates all language, it is extended to all things capable of communicating experiences, and therefore, *ex hypothesi*, of being named. As the representative of nameable things (nouns) it is called *pro noun*. Pronouns as sign-names are convertible. The *first* indicates the *speaker*—whoever he, she, or even (by analogy) *it* may be; the *second*, the person (of what sort so ever) *spoken to*; and the *third*, whoever (or whatever) has occasioned (or felt) the experience *spoken of* by the first to the second. To the above seven parts of speech English grammarians generally add the *article*, and often the *interjection*.

The English language has reduced its grammatical elements to the merest minimum, and gains its precision less by much-expressive compounds than by numerous distinct single words, the unity sought being rather that of signification than of form. We shall here state the more important of those peculiarities in which the English differs from other languages, taking no note of dialects, idioms, provincialisms, vulgarisms, or archaisms, but limiting ourselves to pure English. Its words are either—1, notional, or 2, relational. The former include words denoting (1) existence, and yielding ***nouns*** and *pronouns*; (2) quality, supplying ***adjectives***; and (3) action, introducing *verbs*; the latter comprising (*a*) relations of things, *prepositions*; (*b*) of qualities, ***adverbs***; and (*c*) of thoughts, *conjunctions*.

Nouns may be classified in regard to ***thought*** as (1) *proper*, the names of individuals; and (2) ***common***, names equally applicable in the same sense to many objects. These may be (*a*) *sensible*, as knife; (*b*) *ideal*, as poem; (*c*) *collective*, as multitude; (*d*) *abstract*, as joy, defect, &c. As regards *form* common nouns may be *singular* or *plural*. They form their plurals by (1) adding ***s***; but (2) when ***s*** cannot be euphoniously added—as in words ending in *ch* (soft), *sh*, *s* or *es*, *x* or *o* (short)—the plural is formed by adding *es*, as porch-es, flash-es, kiss-es, fox-es, echo-es, &c.; (3) nouns ending in *f* or *fe*, which commonly follow the general rule, sometimes change *f* into *v* before adding *s* or *es*; (4) singular nouns ending in *y* preceded by a consonant or *u* change *y* into *i*, and add *es*, as daint*ies*, colloqu*ies*; (4) a few old English forms are still in use, as man (with its compounds), ***men***; cow, *kine*; sow, *swine*; child, *children*; foot, ***feet***; goose, ***geese***; tooth, *teeth*; mouse, *mice*, &c. Proper, collective, and abstract nouns, names of metals, materials, and things weighed or measured, are generally used in the singular only. Words derived from foreign and classical languages (unless naturalized) retain their own plurals. *Gender*, or distinction of sex, even when speaking of living beings, is, as far as possible, left unindicated in modern English. When, however, it is desirable to do so, we either use (1) different words, as horse, *mare*; (2) a prefix denotive of sex, as *he*-goat, *she*-goat; *man*-servant, *maid* servant; (3) or suffixes, *ess*, *i.e.*, *ine*, *a*, or other borrowed form. Names of living beings which may be of either sex are called, as regards gender, ***common***, while names of inanimate things and of creatures whose sex it is unimportant to indicate are said to be of the *neuter* gender. *Case* is only marked in English nouns to distinguish the originator, container, efficient agent or possessor, and that now chiefly in reference to persons. This is done by adding ***'s*** to singular nouns and plural nouns not ending in *s*, as king's crown, men's hearts, and ' to plural nouns and those having an ***s***-sound ending, as sailors' cheers, conscience' sake. The preposition ***of*** is very generally used before a noun or pronoun to indicate the possessive, as, The crown of the king.

Pronouns are (1) personal, (2) relative, and (3) adjective. Personal pronouns take the number, gender, and case of the nouns for which they stand. They are thus declined:—

				Nom.	Poss.	Obj.		Nom.	Poss.	Obj.
1st	Per.	M. or F.	Singular,	I,	Mine,	Me.	Plural,	We,	Ours,	Us.
2nd	"	"	"	Thou,	Thine,	Thee.	"	Yo or you,	Yours,	You.
3rd	"	M.	"	He,	His,	Him.				
"	"	F.	"	She,	Hers,	Her.		They,	Theirs,	Them.
"	"	N.	"	It,	Its,	It.				

As the speaker and the person spoken to are either really or ideally present, it is needless to indicate *sex*; there is need of ***number***, to give or imply assent or consent, and of ***case***, because the relative state of each is constantly undergoing (mental) change. In the third person, number, gender, and case are each simultaneously indicated.

Self is added to the three persons to form the reflexive personal pronouns, thus—*myself*, *thyself*; *yourself*, *yourselves*; *ourself*, *ourselves*; *himself*, *herself*, *itself*, and *themselves*. Relative pronouns refer or carry back our thoughts to some antecedent or previous noun; they are *who*, *which*, and ***that***. ***As*** is used as a relative after *same* and ***such***. Who has ***whose*** for its possessive and ***whom*** for its objective. *Who*, *which*, and *what*, when used in asking questions, are called interrogative pronouns, and when these have ***ever*** or ***soever*** added to them they form compound relatives. Adjective pronouns are (1) possessive—*my* (***mine***), *thy* (*thine*), ***his***, ***her***, ***its***, ***our***, ***your***, ***their***, and *own*; (2) demonstrative, pointing out particular nouns precisely—***this***, *these*; ***that***, ***those***; ***former***, ***latter***; ***you***, *yonder*, *selfsame*, and ***such***; (3) distributive, denoting separately the things which make up a whole—***each***, ***every***. *either*, ***neither***; and (4) indefinite, referring to things in a general manner—*all*, *another*, *any*, *aught*, ***both***, ***certain***, *divers*, *else*, *few*, *much*, *many*, ***naught***, ***none***, ***one***, ***other***, *several*, *some*, *sundry*, *whole*. ***One***, ***other***, and ***another*** may be used in the possessive case, and ***other*** takes the plural. *There* is used as an indefinite nominative pronoun, as, There may be a cause for this.

Adjectives are descriptive words. They name the qualities, properties, peculiarities, accidents, quantity, or number of objects. Of these, two, ***a*** or ***an*** and ***the***,

have received the name of articles. *A* or *an* limits the noun before which it stands to *one*, as, a fish; and is therefore called *indefinite*. It also generalizes a proper noun and makes it common, as, He may be a Wordsworth, but is not a Shakspeare. *The* distinguishes special objects which (1) are well-known, as, The Queen; (2) require to be indicated with precision, as, The book with the gold clasps; (3) have been mentioned before, as, The man you sought is found. It is therefore called *definite*. Adjectives denoting qualities which may be increased or diminished are inflected by comparison. The *positive* degree expresses the quality simply, as *hot*; the *comparative* a higher or lower degree of the quality, as *hotter*; the *superlative* the highest or lowest degree, as *hottest*. Adjectives of one syllable, or dissyllables which end in *le* or *y* (changeable into *i*), add *r* or *er* for the comparative, and *st* or *est* for the superlative. *More* or *less* and *most* or *least* are prefixed to words of two or more syllables, as *joyful*, *more joyful*, *most joyful*. Many adjectives are uninflected. A few old forms of adjectival comparison still remain in use, as *bad*, *evil*, or *ill*, *worse*, *worst*; *fore*, *former*, *foremost* or *first*; *good*, *better*, *best*; *late*, *later* or *latter*, *latest* or *last*; *little*, *less*, *least*; *much* or *many*, *more*, *most*; *old*, *older* or *elder*, *oldest* or *eldest*, &c.

The verb affirms. It is the principal word in every sentence. We impress and are impressed, and we regard all things else as like ourselves in that. When, in affirming, we think most of (1) the act of impressing, the verb used is *active*; (2) of being impressed by an action, the verb is *passive*. If the verb express existence, state, or act complete in itself, it is *intransitive*; but if the act is incomplete without an object on which it operates, it is *transitive*. Verbs are inflected to indicate mood, tense, number, and person. *Mood* refers to the manner in which the affirmation made by a verb is presented to the mind. It is *indicative* when a direct statement is made about it; *subjunctive* when the action expressed depends on some condition; *imperative* when command is given or entreaty made. The imperative is used only in the second person. The indicative has distinctly inflected forms. The inflected subjunctive is now—except in the case of the verb *to be*—seldom employed. Because these are limited by considerations of time, number, person, &c., they are finite moods. The infinitive mood is only the name-form of the verb. *Tense* indicates *time*—past, present, and future. The present and the past have inflected forms. Personal verbs have three persons in each number. *Conjugation* signifies the bringing together of all the forms in which a verb can be used. Conjugations are, (1) old, strong, or irregular, and have *seven* inflection-forms; and (2) new, weak, or regular, which have only *six*. These are arranged thus:—

1. Strong Conjugation.

Present Tense.

	Singular.	*Plural.*
1st Per.	I tell.	We tell.
2nd "	Thou tellest.	Ye or you tell
3rd "	He tells (or telleth).	They tell.

Past Tense.

1st "	I told.	We told.
2nd "	Thou toldest.	Ye or you told.
3rd "	He told.	They told.

Imperative, Tell. Infinitive, To tell.
Participles—Imperfect, Telling; Perfect, Told.

2. Weak Conjugation.

Present Tense.

	Singular.	*Plural.*
1st Per.	I use.	We use.
2nd "	Thou usest.	Ye or you use.
3rd "	He uses (or useth).	They use.

Past Tense.

	Singular.	*Plural.*
1st Per.	I used.	We used.
2nd "	Thou usedst.	Ye or you used.
3rd "	He used.	They used.

Imperative, Use. Infinitive, To use.
Participles—Imperfect, Using; Perfect, Used.

Instead of following the complex conjugation of the ancients we now employ verbs expressive of personal state or feeling as auxiliaries for indicating mood. These we use to denote, (1) existence—*am*, *was*, *been*; (2) activity or progress—*do*, *did*, *done*; (3) ability—*can*, *could*; (4) possession—*have*, *had*; (5) permission asked or granted—*let*; (6) possibility, natural or acquired—*may*, *might*; (7) duty (moral)—*ought*; (8) necessity—*must*; (9) obligation (enforced)—*shall*, *should*; (10) intention—*will*, *would*. The two last-mentioned interchange in different persons. When indicating futurity (*a*) dependent on the speaker's will the use is—I, we will; He, you, they shall; and (*b*) independent of the speaker's will—I, we shall; He, you, they will. Some verbs used only in the third person, as *it rains*, are called *impersonal*.

Adverbs for the most part modify verbs; occasionally they affect the meaning of adjectives. They may be classified as of—1. Time, (1) present, *now*, *instantly*; (2) past, *before*, *lately*; (3) future, *henceforth*, *hereafter*; (4) continuous, *always*, *still*; (5) indefinite, *sometimes*, *often*. 2. Place, as to (1) position, either (*a*) near, as *here*, *close by*; (*b*) *there*, *afar*; or (*c*) indefinite, *where*; (2) direction, *to*, *towards*, *from*, *thither*; (3) succession, *firstly*. 3. Manner in relation to (1) affirmation, *yea*; (2) negation, *nay*; (3) similarity, *alike*; (4) difference, *otherwise*; (5) quantity, *much*; (6) quality, *fairly*; (7) union, *together*; (8) separation, *asunder*; (9) comparison, *less*; (10) illustration, *namely*; (11) mode, *headlong*; and (12) degree, *enough*. Phrases and clauses are often used as adverbs, as *post haste*, *with railway speed*, *as light as a feather*.

Prepositions are words placed before nouns to denote the relationship which they bear to each other, as *above*, *through*, *beyond*, *under*, &c. Many phrases are used as prepositions, as, *in spite of*, *in connection with*, &c.

Conjunctions connect ideas, thoughts, and expressions. They are either (1) Co-ordinating, (*a*) as additions, *also*, *and*, *besides*; (*b*) as oppositions, *but*, *only*, *first*, *next*; and (*c*) as relations, *because*, *hence*, *so that*, *therefore*; or (2) Subordinating, (*a*) correlative, *so*, *that*, *though*, *yet*; (*b*) conditional, *if*, *lest*, *since*, *although*, &c.

Interjections are indications of emotion. They do not form integral parts of those sentences in which they occur; and rather hold an indefinite place on the border-marsh between significant and non-significant sound, than among the parts of speech.

Syntax regulates the construction of sentences. A sentence is the expression of a complete thought. The simplest expression of thought is the joining of a subject and a predicate, as, *Man speaks*. The former is the idea under the mind's observation while thinking, the latter is what is affirmed concerning it. Each of these may be enlarged by adding words or phrases. Additions to the subject are called *enlargements*, to the predicate *complements*. The chief object of syntax is so to arrange words as most exactly to express all the relations, connections, successions, and influences of our ideas, and thus to give adequate and accurate utterance to our thoughts. It teaches us to attend to (1) the order, (2) the concord, and (3) the government of words. *Order* is either logical or rhetorical. Logical order requires words to be so placed as to bring out most clearly the intended meaning. The law of rhetorical order is that words should be so joined as to set forth our ideas most effectively for the end we have in view. Adverbs require especial care that no doubt may be left in the mind regard-

ing the word to be affected by them. *Concord* is the agreement in number, gender, case, and person, of all words having reference to each other, in order that consistency of expression and unity of impression may be secured. Hence, (1) a finite verb agrees with its subject, which must be put in the nominative case. The number of the subject depends more on its meaning than its form. (2) Pronouns, personal and relative, agree with the nouns they represent; adjectives and adjective pronouns with the nouns they qualify or to which they refer. (3) Words signifying the same thing, in the same relation, are put in the same case. *Government* signifies the power which one word exercises over another to require any change in its inflection. In this way, (1) transitive verbs (with their participles) require their direct complements to be put in the objective case. (2) When two or more nouns come together one of which belongs to, is contained in, or owes its origin to, the other, the latter is put in the possessive case. (3) Prepositions take the objective case after them. (4) Finite verbs (as well as some nouns and adjectives) are often followed by an infinitive. The supreme canon of syntax is that a precise and thoroughgoing consistency of thought and phrase must be observed and attained in the construction of sentences. The relations of sentence to sentence, and the development of one truth from another, belong rather to rhetoric and logic than to grammar.

GRAMMAR SCHOOLS. The Roman *grammatici* studied Greek as we do Latin. They established schools early at Rome, and under the empire similar seminaries were established in all the most famous cities subject to its rule. Grammar, as the first step in the *Trivium*, was taught in all these schools, and hence those places of instruction in which the laws of language were expounded were called grammar schools. In York, under Alcuin, we find the most celebrated of the Saxon grammar schools, and through Alcuin, in the reign of Charlemagne, the Palatine model school for the new Western Empire was established. The model was extensively adopted, and all the elements of knowledge, communicated through the Latin tongue, were taught in those ancient houses of learning, which at first preceded and latterly became preparatory to the universities. A grammar school is properly one in which the learned languages of Greece and Rome are the fundamental studies, and this has been fixed by many judicial decisions as the legal meaning of the term. Grammar schools have long been regulated by schemes prepared under the sanction of and orders passed by the Court of Chancery. A select committee of the House of Commons in 1818 gave in a report on 440 endowed grammar schools, which led to "An Act for Improving the Condition and Extending the Benefits of Grammar Schools" (1840), by placing them under the care of the Court of Equity, and empowering the Court of Chancery to extend and improve the education they give. The six great public schools—Eton, founded in 1441; Winchester, 1387; Westminster, 1560; Charterhouse, 1611; Harrow, 1571; Rugby, 1567—were dealt with and put on a solid basis; and under the royal commissions which have since been issued to inquire into and to organize the middle-school education of England, Scotland, and Ireland, considerable progress has been made in extending the course and improving the conditions of instruction in all the important grammar schools in the empire. Shrewsbury, 1551; St. Paul's, London, 1509; Merchant Taylors', 1561; Uppingham, 1584; Christ's Hospital, 1553; Edinburgh Royal High School, Aberdeen Grammar School, Heriot's Hospital, Dublin High School, Londonderry College, &c., are among the oldest of our historic grammar schools.

GRAMMARIANS or **GRAMMAT'ICI,** among the classical ancients, a title of literary distinction and honour. Suetonius has written a history of the celebrated grammarians of the Roman Empire. Philoponus, a celebrated philosopher and scholar of Justinian's time, was surnamed *Grammaticus* by way of honourable distinction. The title was not confined to mere pedagogues, but bestowed on those who distinguished themselves in the higher walks of literature and criticism. In fact a *grammaticus* was nearly akin to our philologer. Before the time of Crates, surnamed *Mallotes*, who lectured on grammar between the second and third Punic wars, it was not even known by the Romans what was the meaning of the term; but Rome afterwards became distinguished above all other nations for the number and brilliancy of her grammarians, whose writings still continue to be read and admired, as Aristarchus, Dionysius, Didymus, Flaccus, Quintilian, &c. During the second century of the Christian era the most celebrated grammarians were Pollio, Eutychius, Athenæus, Julius Pollux, Macrobius, and Aulus Gellius, whose works relate not only to criticisms of ancient writers, but to the general literature of Greece and Rome.

GRAMMATICAL ANALYSIS may refer (1) to separating the words in sentences into the parts of speech; (2) to indicating the inflexion of the several words in any sentence; (3) to bringing each word in a sentence under the rules of syntax; and (4) to breaking up a sentence into its several component parts, each contributory to the completeness of a statement. An ordinary knowledge of grammar will enable any one to do the first three, the last is a matter of more difficulty. The following directions simplify the task. As every sentence consists of two parts—a name or its equivalent, as *subject*; and an affirmative or verb, as *predicate*—each sentence may be separated into these two—*e.g.* Go (*pred.*) thou (*sub.*) Sentences may be—(1) *simple*, containing only one subject and one predicate; (2) *compound*, in which two (or more) sentences are combined or co-ordinated. "John came home yesterday, James came home yesterday," may be combined into "John and James came home yesterday;" and, "William promised, Robert performed," may be combined as "William promised but Robert performed." (3) *Complex*, containing a principal sentence round which other sentences, clauses, or phrases are grouped; as, The law has now decided that you are wrong. Here we have (*a*) The law has decided (somewhat), (*b*) now (a phrase, equal to "at the present time"), (*c*) you are wrong, (*d*) that, a connecting or conjunctive phrase subordinating the independent sentence "you are wrong" to the principal one "the law has decided." *Enlargements* affect or modify the subject, and may be nouns or noun-phrases, adjectives or adjectival phrases, or adverbial phrases modifying adjectives. *Complements* modify the predicate, and may be of the same three sorts. Conjunctions or conjunctive phrases unite either the principal or the inferior parts. To analyze, therefore, we require—

1. To separate each sentence into all its (possible) component simple sentences (if any).
2. To separate each simple sentence into all its component elements.
3. To arrange all the parts of each sentence in the order of their importance.
4. To write down the nature of each sentence, clause, or phrase as it occurs.
5. To write down the function of each word, as it occurs, in its relation to the sentence.
6. To recognize, note, and describe the relations each sentence, clause, or phrase bears to each of the other parts.

Synthesis is the composition, *analysis* the decomposition of sentences.

GRAMME is the standard unit of French measures of weight, and is equal to the weight of one cubic centimetre of pure water of the temperature of 4° C. (or 39·2° Fahr.) weighed at Paris, or 15·432349 grains troy in English. The other weights are called grammes, with the prefix of the Greek numerals *deca*, *hecto*, *kilo*, and *myria*, according as it is wanted to express 10, 100, 1000, or 10,000 grammes,

or of the Roman numerals *deci*, *centi*, and *milli*, to express tenths, hundredths, and thousandths of a gramme. A kilogramme, or 1000 grammes, is equal to 2·2 lbs. avoirdupois, and a single grain troy weighs ·0648 gramme.

GRAMMONT, COUNT DE, a celebrated personage of the time of Louis XIV., served in the army with great distinction, and rose to the rank of lieutenant-general; but he acquired his celebrity by his great wit and his relations with the most eminent persons of his day. He spent some time at the court of Charles II. of England. During his residence in England he engaged to marry Miss Hamilton. Forgetting or neglecting his promise he set out to return to France, but being overtaken by two of the lady's brothers at Dover, and asked whether he had not forgotten something, "Yes, indeed, I have forgotten to marry your sister," answered Grammont, and immediately returned to complete his engagement. Grammont died in 1707, aged eighty-six. His "Mémoires," which were published by his brother-in-law, Anthony Hamilton, are admitted to be a very clever production of that kind; they abound in wit and animation, and present a lively though sometimes a disgusting picture of the profligate court of Charles II. Of the English editions one of the best is that of 1811, in two volumes, with sixty three portraits and many notes and illustrations.

GRAMPIANS. See ABERDEENSHIRE.

GRAM'POUND, a market-town of England, in the county of Cornwall, situated on the river Fal, which flows through the town, and distant 293 miles from London on the Great Western Railway. The greater part of the town is on the east bank of the river, and consists of one main street on the declivity of a hill. The population is only 482. This small place formerly returned two members to the House of Commons, and was once represented by John Hampden, but was disfranchised for gross bribery in 1824. The name is a corruption of *Grandpont*, great bridge—the river here being crossed by a fine stone bridge, which is now 60 feet above high-water mark. It is supposed to stand on the site of the Roman *Voluba*.

GRAM'PUS is the name commonly given to the *Orca gladiator*, one of the Dolphin family (Delphinidæ). The grampus or killer-whale is pre-eminent among all the cetaceans in strength, ferocity, and voracity. It is a large whale, ranging from 18 to 30 feet in length. The anterior part of the head terminates less abruptly than in any other of the family. It is easily recognized by its flippers and dorsal fin—the former being broad and rounded, the latter long and elevated. The grampus is glossy black above and white beneath, with a white band over each eye. It is an inhabitant of the northern seas generally, and frequently appears on British coasts. The food of the grampus consists partly of fish, but for the most part of mammals, such as seals, porpoises, and even the great sperm and Greenland whales. They are said to hunt in packs like wolves. Grampus is also the name of a genus of Delphinidæ. Risso's Grampus (*Grampus griseus*) resembles externally the Caaing Whale (*Globiocephalus melas*), but the upper jaw is without teeth. It is about 13 feet long, and is remarkable for the variability of its colour. It has been found both on the English and French coasts.

GRANA'DA, a province of Spain, is bounded on the E. by Murcia and Almeria, on the S. by the Mediterranean, on the N. by Albacete and Jaen, and on the W. by the provinces of Sevilla, Cordova, and Jaen. The population is 480,000.

The whole of this province is diversified with majestic mountains, delightful valleys, and wide plains; it has also an extensive line of coast. The Sierras Nevada, Alpujarras, Gador, Bermeja, and Ronda are among the mountains of the province. Mulhacen, one of the summits of the Sierra Nevada, is 11,781 feet high. The Jenil, Guadix, Guadiaro, Guadelmedina, Motril, and Almeria are the principal streams. The mineral springs are numerous. The soil is covered with a luxuriant vegetation. The sumach and the cork trees, the oak bearing the edible fruit, and many other valuable trees and shrubs, form the extensive thickets of the sierras. The soil is very productive and the agriculture good. Metals are abundant in the mountains. There are many iron and lead mines. Copper ore lies on the surface in many places; antimony and quicksilver are found near Malaga, and molybdenum at Ronda. Coal is found on the margins of the Beiro and of the Alfacar, near the capital. Exquisite marbles, jaspers, and alabaster are abundant.

The hemp of Granada is among the finest known. There are manufactures of woollen, cotton, and linen stuffs, paper, and leather, and anchovy and tunny fisheries are prosecuted on the coast.

Granada formed a part of the ancient *Bætica*, and on the destruction of the Ibero-African Empire it became a new state, founded by Mohammed Alhamar in 1238. It remained in the possession of the Moors for 250 years. It was the last possession of the Moors in Spain, and was conquered by Ferdinand and Isabella in 1492. During the Moorish sway it rose t a pitch of intellectual greatness hardly equalled at the time in any other part of Europe.

GRANADA, a city of Spain, capital of the above province, and the seat of an archbishopric, is situated at the foot of the Sierra Nevada.

The early history of Granada is hidden in obscurity. Under the Romans *Illiberis* was a place of some importance, being made by them a municipal colony entitled *Municipium Florentinum Illiberitanum*. The Goths changed the Roman name into Eliberi, and allowed the place to fall into decay. The present city was founded by the Moors in the tenth century, and became a part of the kingdom of Cordova. In 1236 it was strengthened and augmented, in consequence of being selected by Mohammed Alhamar as the capital of his new kingdom. The throne continued in the family of that prince till 1492, when after a year's siege it surrendered to Ferdinand the Catholic. Many Moorish families continued to reside here for a century and a half after its conquest, and contributed to its prosperity and importance. Various attempts to convert them to Christianity were made subsequently to the conquest of Granada, but these having proved, as is alleged, totally unsuccessful, the priest-ridden government of Philip III. resolved, at the instigation of a few bigoted ecclesiastics, to expel the Moors from all parts of Spain. This insane resolution, by which the kingdom was deprived of a large number of its most industrious and valuable citizens, was carried into effect in 1609 and 1610, under circumstances of the greatest barbarity.

The Alhambra, the Generalife, Torres, Bermejas, &c., are the principal memorials of its Arabian grandeur. See ALHAMBRA.

Granada stands on and between two hills. The Darro intersects the city and the Jenil skirts it, and the river banks afford many beautiful shady walks. The aspect of the city at a distance is imposing, but this effect is removed on entering it by the intricacy, steepness, and narrowness of its streets, and by the mean appearance of the houses. In the level parts, however, there are spacious squares. The cathedral, though irregular, is a splendid structure, profusely ornamented, and containing beautiful statues and pictures. The other principal churches are those of San Jeronimo, the Chartreux, las Angustias, and Santa Cruz. There are numerous parish churches, adorned with rich marbles and other works of art, and several convents.

There is an archiepiscopal palace, an extensive general hospital, a Moorish bazaar, a university, six colleges, a mathematical academy, and other educational establishments. There is a royal manufactory for saltpetre and

gunpowder, and several manufactories of silk stuffs, such as velvet, taffetas, satin, handkerchiefs, and ribbons. The sewing silk of Granada is preferred to all others. These manufactures, as well as that of sailcloth, have greatly declined during the present century. The population, which in the time of the Moors was said to be 500,000, is now about 60,000.

GRANA'DA, NEW, is a city of Central America, in the state of and 30 miles N.N.W. from Nicaragua. It was founded in 1522, and was of considerable importance till 1857, when it was nearly destroyed during the revolutionary war. The present inhabitants (about 15,000) trade in cocoa, indigo, Nicaragua wood, and hides, which are exported in flat-bottomed boats by the lake and river San Juan to the harbour of San Juan del Norte in the Caribbean Sea. Efforts are being made to restore the city to its former importance and prosperity.

GRANA'DA, NEW. See COLOMBIA, UNITED STATES OF.

GRANADIL'LA, the name applied in Brazil to the fruit of *Passiflora quadrangularis*, which is sometimes as large as a child's head, and contains in the centre of a thick fleshy rind a large quantity of seeds surrounded by a subacid pulpy mucilage. It is much esteemed in tropical countries as a pleasant dessert-fruit, and is occasionally seen in this country. Other species of Passiflora afford edible fruits, which are also called granadillas.

GRANBY, MARQUIS OF (JOHN MANNERS), was the eldest son of John, third duke of Rutland, and was born on the 2nd of January, 1721. He raised a regiment of foot for the king in the rebellion of 1745. For this he received the coloneley of the Horse Guards, and went abroad in the Seven Years' War as lieutenant-general. At the battle of Minden he was complimented by Prince Ferdinand of Brunswick, at the expense of his superior officer, Sackville, who was ultimately cashiered for his conduct on that occasion. He commanded during the rest of the Seven Years' War, and in 1766 was made permanent commander-in-chief. He died 20th October, 1770. His great popularity (not very well deserved) is shown by the number of old inns that still bear his name. Every reader of Charles Dickens knows that one of them was the property of the immortal Weller family.

GRAN-CANAR'IA or **CANARIA,** one of the Canary Islands, in the Atlantic, on the west coast of North Africa. It gives the name to the whole group, and is situated to the east of Teneriffe. It is nearly circular, and its area is 758 square miles. The highest point, El Cumbre, or Pico del Pozo de las Nieves, is 6648 feet above the sea. The mountain Saucillo, near the centre of the island, is 6070 feet high, and is surmounted with a large wooden cross. Port-la-Luz, which affords good anchorage and is well sheltered from the north-east winds, is formed by Isleta, a rocky promontory joined to the island by a low isthmus. Las Palmas is the capital of the island.

GRAND ASSIZE, THE, was part of the legislation of Henry II. as preserved for us in the pages of Glanville. It was a development of that inquest into facts by the help of a jury of recognition which was an old custom in England, and which the Conqueror had wisely organized and used for the preparation of Domesday Book. Henry II. carried the system still further, and used it also in judicial matters. The system was brought into the form known as the Grand Assize. Any one whose possession of his freehold was disputed, for instance, might refuse trial by battle, and claim instead to have the question tried by twelve legal knights of the neighbourhood, chosen by four legal knights of the county, three by each. The chosen twelve then were to swear which of the disputants had the best claim. If unanimous on one side or the other the verdict followed; if not, others were added to them until twelve did agree. This was the true beginning of the "palladium of British justice," the trial by jury, and not the custom under Alfred and other early English kings of a trial by compurgation, which proceeded on quite another principle.

GRAND JUNCTION CANAL, THE, forms, in connection with several others, a complete system of water communication between London, Liverpool, Bristol, and Hull. It commences at Braunston, on the west borders of Northamptonshire, and enters the Thames near London—its total length being 128 miles. It was executed between 1793 and 1805.

GRAND RAPIDS, an important manufacturing town of the United States, in Michigan, capital of Kent county, situated on the falls of the Grand River, 40 miles from its mouth, and 60 miles W.N.W. of Lansing. The town is well built in a fine situation, and is connected by steamers with the navigation of Lake Michigan. In addition to the advantages thus afforded to the trade of the town, it is a place of junction for six railways. It possesses the usual buildings and institutions of a growing town, and has manufactures of wooden goods, machinery, chemicals, leather, beer, and bricks. Gypsum is very abundant in the vicinity. Grand Rapids was settled in 1833, and incorporated in 1850. Population, 32,016.

GRAND-SERJEANTY, the noblest of the ancient English tenures. Tenure by grand-serjeanty is where a man holds his lands or tenements of the king by such services as he ought to do in his proper person to the king, as to carry the banner of the king, or his lance, or to lead his army, or to be his marshal, or to carry his sword before him at his coronation, or to be his carver, or his butler, or to be one of his chamberlains of the receipt of his exchequer, &c.

GRANDEE'. *Grande de España* is the name of the highest rank in the Spanish nobility. The grandees were originally the descendants of the great feudatories of the crown, but since the time of Don Carlos I. (Charles V. of Germany) it became the practice of the Spanish kings to raise new men to the rank of grandees, which occasioned a distinction between the old and the new grandees, marked by the old ones addressing each other in the second person singular, "thou;" while those of a recent creation were addressed by the title of "your excellency," which belongs to all Spanish grandees. The collective body of the grandees is called La Grandeza, and by the constitution of 1875 they are members of the Upper House or senate by their own right. Grandees have several exclusive privileges, among which is eligibility to the order of the GOLDEN FLEECE of Spain.

GRANGEMOUTH, a town and port of Scotland, in the county of Stirling, situated at the mouth of the river Carron, near the Frith of Forth, at the junction of the Grand Canal with the Carron. It is a station on the North British Railway, being 4 miles N.E. of Falkirk and 432 from London. The town was commenced in 1777 by Sir Lawrence Dundas, in the well-founded expectation that its connection with the canal would give it some consequence as a port. Having been built on a regular plan, the streets are well laid out, and there are some good neat houses. From the flatness of the surrounding country and the adjacent sea-dykes and canal, the place has the appearance of a dutch village. The Grand Canal terminates here in a basin and harbour. Vessels of large size can lie alongside the quays, and smaller ones can proceed by the canal, the traffic on which is very considerable. Great efforts have been made of late years to improve the port, resulting in the construction of a dock, opened in 1882, with an area of 19½ acres, of which 10½ acres are actual dock room, and 8 acres a timber basin with a depth of 8 feet. On the sill there are 26 feet of water, and outside the gates 8 feet at low water, with a rise at spring tides of 18 feet and at neap of 14 feet. The old dock, opened in 1843, has an area of 7¼ acres, but it

has only a depth of 17 feet over about one-half of it, the remainder being about 13 feet in depth. The town has several churches, a custom-house, and a large park. There are also extensive quays and warehouses. Steamers ply between it and London, Hamburg, Stettin, Rotterdam, and other ports. The chief exports are iron goods, grain, and wool; but the manufacturers of Stirling and St. Ninians also send their goods to be exported from Grangemouth. The chief article of foreign import is timber; and shipbuilding is carried on to a considerable extent. The number of vessels registered as belonging to the port in 1884 was 70 (12,000 tons). The entries and clearances each average 1700 (530,000 tons) per annum. The population of the town in 1881 was 4560. Kerse House, the seat of the Earl of Zetland, stands in a finely wooded park near the town.

GRANI'CUS, the ancient name of a river of Asia Minor, in Anatolia, entering the Sea of Marmora 30 miles west of the peninsula of Cyzicus. It rises on the northern side of Mount Ida, and has a course of about 60 miles. It is famous as the scene of Alexander's first decisive victory over Darius, 334 B.C. Its modern name is Karakasu.

GRAN'ITE, a well-known igneous rock, composed of the three minerals quartz, felspar, and mica, united in a confused crystallization, that is, without a regular arrangement of the crystals. It is called granite on account of its granular structure. See IGNEOUS ROCKS.

GRANT, SIR JAMES HOPE, G.C.B., a general of the British army, was born in 1808, and in 1826 became cornet in the 9th Lancers. After fifteen years of home service he was despatched as brigade-major to Lord Saltoun during the China War, and at its close in 1844 went to India, where he greatly distinguished himself in the Sikh campaign under Sir Hugh Gough. He also played a conspicuous part in the Punjab campaign of 1848–49. The principal features in the Indian career of Sir Hope Grant, however, occurred during the great mutiny of 1857. He established a splendid reputation as a cavalry general before Delhi, and throughout the whole period of the outbreak was perhaps more actively engaged than any other officer who took part in its suppression. Always in the front, and always at the post of difficulty, a complete narrative of his engagements would form a not very imperfect history of the whole war; while the achievements he performed, said Lord Granville in the House of Lords, "seem more like the prodigies of valour recounted in the pages of an ancient romance than actual historical events occurring in our own times." Lord Clyde, alluding to the services of Sir Hope at Delhi, Lucknow, Cawnpore, and on the Gogra, spoke in terms equally eulogistic of the general, upon whom he had placed unlimited reliance. Sir Hope Grant was appointed to command the English part of the Anglo-French expedition against China after the repulse of the allied squadrons at the Peiho forts. In four months the allies marched from the sea to Pekin, routing the Chinese armies again and again, storming the Taku forts, occupying the imperial palace, and exacting an important treaty from the Chinese. He subsequently held various high appointments at home, and in 1870 succeeded Sir J. Scarlett in the command of the camp at Aldershot, where he was as much respected for his qualities as a most gallant and sagacious British soldier as he was beloved for his simple-minded kindness of heart, and above all for his earnest and practical piety. He died 7th March, 1875.

GRANT'HAM, a parliamentary and municipal borough and market-town of England, in the county and 23 miles S.S.W. of Lincoln, is situated on the west bank of the Witham, 105 miles from London by the Great Northern Railway, and is connected with the Trent by means of a canal 30 miles long. There is a corn exchange, with large rooms for concerts and meetings. On St. Peter's Hill, where stands a bronze statue of Sir Isaac Newton, who received part of his education here, a new town-hall was erected in 1869. The Philosophical Institute is a handsome building, with good museum and library. Besides the fine parish church, there are several dissenting chapels, and a first-grade school, founded as a grammar-school in 1528, and remodelled in 1876. Besides the well-known agricultural implement factory and iron-foundry of Messrs. Hornsby, there are breweries, tanneries, and coach-building works. The population of the parliamentary borough (which returns one member) is 17,345, while the number of voters is about 2600. The municipality is composed of four aldermen, including the mayor, and twelve councillors. The town is known to have been the seat of a suffragan bishop long before the Norman conquest.

GRAN'ULITE or **LEP'TINITE** is a rock mostly composed of orthoclase and quartz; red garnets are usually also present. It has a schistose structure, is evidently of metamorphic origin, and occurs along the margin of many granitic masses. Kyanite and schorl are not uncommonly also constituents.

GRANVILLE, a seaport and walled town of France, in the department of Manche, 15 miles N.W. of Avranches, having the island of Jersey in sight. It has a tribunal of commerce, a naval school, and 9813 inhabitants. The town stands on a rocky promontory projecting into the English Channel, 30 miles S.W. of St. Lô. The principal public buildings are the parish church, custom-house, granite mole (inclosing a harbour which is accessible to vessels of the largest tonnage), citadel, hospital, and public baths. There is a floating dock, and the rise and fall of the tide is at times as much as from 40 to 44 feet. The inhabitants of Granville are enterprising seamen, and are largely engaged in the coasting trade and in the cod, herring, whale, and oyster fisheries. They export corn, flour, butter, cider, poultry, cattle, granite blocks, &c., and import wine, brandy, colonial produce, drugs, salt, hemp, soap, oak and deal planks, iron, &c. Shipbuilding is carried on. Granville is the seat of a tribunal of commerce, and has a school of navigation. It was destroyed by the English in 1695, and besieged by the Vendeans in 1793.

GRAPE. See VINE.

GRAPE-SHOT or **TIER-SHOT** was the name given formerly to a projectile consisting of a series of small iron balls arranged between a series of parallel iron plates held together by a pin passing through the centre. A stout canvas bag was also drawn over the projectile, and it was further strengthened with cord. Designed to separate immediately on leaving the muzzle of the gun, grape-shot could only be employed at short ranges, but it was terribly effective when used against masses of men at close quarters. Instead of using grape-shot reliance is now chiefly placed upon the various machine guns that have been introduced, which not only fire their bullets with terrible rapidity, but have an effective range three or four times greater than any form of grape or case shot.

GRAPHITE. See PLUMBAGO.

GRAPHIT'IC ACID, an acid obtained from graphite by Brodie. It results from the action of potassium chlorate and nitric acid on the mineral, forms transparent crystals of the trimetric system, and is soluble in water if pure, but salts and acids prevent the solution. The formula is $C_{11}H_4O_5$. It decomposes violently when heated. It unites with alkalies and alkaline earth, forming graphitates, which detonate on heating. When precipitated by an acid from an alkaline solution it forms a jelly resembling silicic acid. It is interesting as the only acid obtained from carbon by direct oxidation.

GRAPH'OTYPE, a process accidentally discovered by an American draughtsman, by which an artist's design may be at once produced in relief without the trouble and expense of engraving. The usual mode of graphotyping is to distribute upon a sheet of metal perfectly flat an even layer of finely pulverized French chalk, upon which is laid

a steel plate, such as is used by engravers. It is then submitted to pressure in a powerful hydraulic press, and on removal the chalk is found to have assumed the form of a solid and compact mass of concrete, with a face similar to that of an enamelled card, which is rendered still more solid by a weak coating of size. When dried, the plate is ready to be drawn upon; this is done with an ink composed chiefly of lampblack, gluten, and a chemical compound which prevents the fluid from drying until it is brought into contact with the chalk plate. When the drawing is finished, the chalk untouched by the artist is quietly brushed away in five minutes, leaving all the ink lines standing out in relief. If the size is too strong it holds the chalk together and interferes with this brushing away. The brushing, at first done by hand, was afterwards usually accomplished by machinery. Those parts in relief are then saturated with a chemical solution, which renders them as hard as marble, and the drawing is ready for the stereotyper or electrotyper, who produces from it a metal block from which impressions can be taken to any extent.

For the rougher kind of humorous sketches, where force of outline makes up for delicacy of touch, graphotype is not ill adapted; but for finer work it suffers under a fatal technical defect—namely, that every line is practically permanent as it is laid by the brush, corrections by the artist being impossible. If corrections are necessary they have to be executed by the workmen, who are alone able to manipulate the process. In consequence of this, and the inability of the soft chalk surface to bear a line from a pen or ruler, &c., graphotype has died out as a working process, and is superseded by the easier and more elastic methods of *photogravure* (originally called *gillotype*, from the French inventor), *photo-relief*, and *typographic etching*.

GRAPPLING-IRON or **GRAPNEL**, an instrument used in fastening boats and small vessels; it is somewhat like a small anchor, and has several pointed claws. A larger grapnel was formerly used during a sea-fight to lay hold of the rigging of a hostile ship before boarding her. Grappling irons are also used in the descent of balloons.

GRAP'TOLITES is a group of fossil animals exclusively confined to the Upper Cambrian and Silurian strata. The Graptolites are usually classed as a suborder of HYDROZOA, but from the imperfect nature of the remains their true position in the animal kingdom must remain doubtful. Professor Nicholson ("Monograph of the British Graptolitidae") regards the living Sertularia as their

Fig. 1.

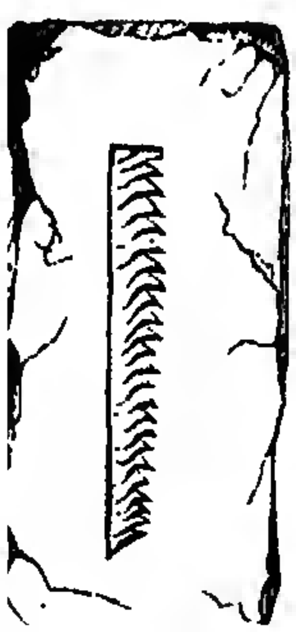


Fig. 2.

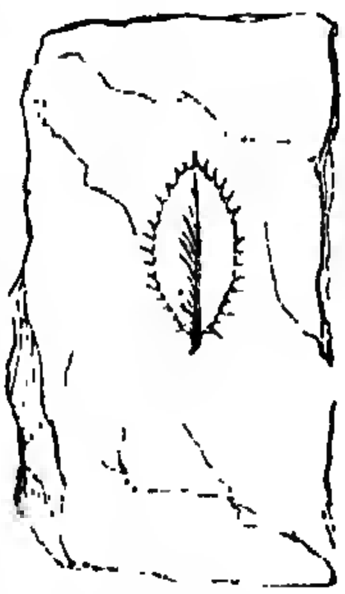


Fig. 3.

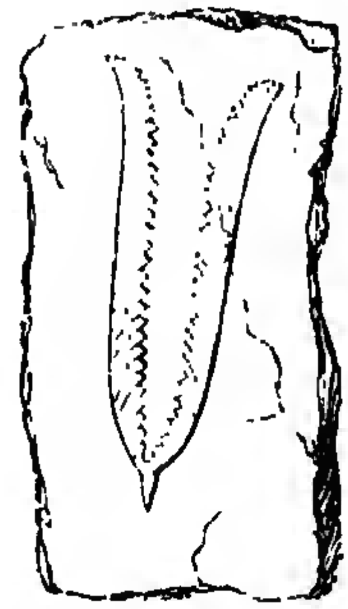
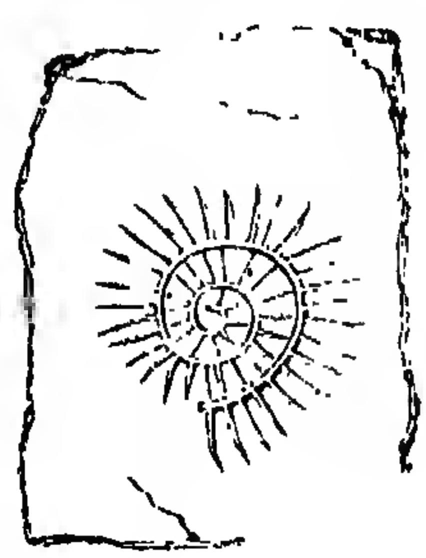


Fig. 4.



nearest allies. Graptolites have usually long narrow bodies, toothed upon one or both sides. Nicholson regards these fossils as forming a colony of polyps united by a common trunk (*cœnosarc*), which latter was inclosed in a horn-like tubular covering (*polypary*) with little cup-like expansions or cellules (*hydrothecæ*) protecting the polyps. The polypary was usually strengthened by a chitinous rod or fibre, the so-called solid axis. The polypary was not attached to any foreign body, as in Sertularia. The genera are not very numerous; the chief are:—Graptolites, or those which have a single row of cellules united at the base—fig. 1 shows a species of this genus, *Graptolites priodon*; Diplograpsus, or such as have two rows of cellules united along the base, and sometimes having a leaf-like appearance, as for example in *Diplograpsus folium* (fig. 2); the genus Didymograpsus (fig. 3), in which the polypary consists of two branches, each with a single row of cellules, and springing from a common point; and Rastrites, or rake-like graptolites, in which the cellules are not united at the base, but arranged at intervals along the axis; the cellules do not overlap as in other graptolites; fig. 4 shows *Rastrites peregrinus*.

GRAS'MERE, a village and lake, inclosed by mountains, in the county of Westmorland. It forms one of the prettiest views in England, and its ancient churchyard contains the grave of the poet Wordsworth, which is covered by a plain stone. The mountains rise to the height of 3000 feet, and the lake is a mile long, half a mile broad, and incloses a small island.

GRASS LAND may be divided into water meadows, upland pastures, and artificial grasses. The first are treated of under IRRIGATION; the nature and management of the last two we shall here briefly describe. Upland pastures are portions of land on which the natural grasses grow spontaneously, varying in quantity and quality with the soil and situation. When a pasture land is naturally rich, the only care required is to stock it judiciously, to move the cattle frequently from one spot to another, and to eradicate certain plants which are useless or noxious. The urine of the cattle is the manure which keeps up the fertility of grass land. A poor arid soil is not fitted for grass, nor one which is too wet from the abundance of springs and the want of outlet for the water. These defects can only be remedied by expensive improvements.

When old meadows have been neglected or too often mown they produce nothing but a coarse sour grass. In that case, besides draining it if required, the land must be broken up and undergo a regular course of tillage, until the whole of the old sward is destroyed. The proper method of treating such land is to sow no more corn crops than will pay the expense of breaking up, carting earth, lime, or other substances upon it, to improve the soil, and to lay it down to grass again as soon as the old sward is fully destroyed.

If the soil is fit for turnips, no better crop can be sown to prepare for the grass seeds. Turnips of an early kind may be sown in May, and fed off with sheep in August or September; and the ground being only very slightly ploughed, or rather scarified, and harrowed fine, the seeds may be

sown and rolled in. The species of grasses sown must depend on the nature of the soil, but it is impossible to be too choice in the selection. The quantity per acre of the mixed seeds should not be less than 30 or 40 lbs., to insure a close pile the next year. If the soil is not naturally rich liquid manure should be used. Sometimes, in soils not congenial, recourse is had to inoculating grass. This is done by taking pieces of sward from an old meadow and spreading them over the surface of the land to be laid down, after it has been ploughed and prepared. This is a very effectual method of producing a permanent pasture.

When an arable field is sown with the seeds of grasses and other plants which give herbage for cattle, it is called an artificial meadow. Clover in this case is always a principal plant, both the red and the white; these, with annual or perennial rye grass, are sown with a crop of corn in spring, and begin to show themselves before harvest. The seeds usually sown on an acre, when the land is laid down to grass, are as follows:—Red clover, 12 lbs.; white, 6 lbs.; trefoil, 4 lbs.; rib grass, 2 lbs.; and 2 pecks of Pacey's rye grass. Sometimes cockfoot grass (*Dactylis glomerata*) and cow grass (*Trifolium medium*) are added. This is for a field intended to remain four or five years in grass.

The introduction of artificial meadows in districts where the soil seemed not well adapted for pasture has greatly increased the number of cattle and sheep reared and fattened, and has caused greater attention to be paid to the means of improving the breeds of both.

In the neighbourhood of large towns there are many meadows which, without being irrigated, are mown every year, and only fed between hay harvest and the next spring. These require frequent manuring to keep them in heart, and with this assistance they produce great crops of hay every year. The management of this grass land is well understood in Middlesex. The grazing of cattle is generally considered a more profitable occupation than simply tilling the land; though the capital required is considerable, yet the current expenses are not great. By uniting the raising of corn and the grazing of cattle and sheep, the greatest profit is probably obtained, and this is the great argument in favour of the convertible system of husbandry. According to the official agricultural statistics published in 1884 there were in the United Kingdom in that year 6,400,000 acres of clover and other artificial grasses under rotation, and 25,000,000 acres of permanent pasture not broken up in rotation (exclusive of heath or mountain land).

GRASS, CHINA, is a strong fibre, which has long been used in China for the manufacture of a beautiful fabric known as grass-cloth, and has attracted the attention of practical manufacturers in this country. It is identical with the Rhea fibre of India. Since a simple and effective method of preparing it for use, chiefly depending on the solvent powers of a hot solution of carbonate of soda, was devised, this grass has become one of the component fibres of many mixed fabrics, but much grass-cloth is still brought to Europe from China—especially in the form of pocket-handkerchiefs, which are peculiarly transparent, and have a fine glossy appearance. See BOEHMERIA.

GRASSE, a town of France in the department of Alpes Maritimes, situated on the slope of a high hill, 23 miles E. from Draguignan. It has civil and commercial tribunals, a college, an ecclesiastical school, and 11,342 inhabitants. The chief manufactures are of coarse woollens, silk, linen, thread, liqueurs, brandy, olive-oil, soap, leather, and a great quantity of essences and perfumes, particularly those made from orange flowers, roses, mint, &c. There is also a good trade in fruit. The houses of the town are well built, but the streets are steep, crooked, and narrow. In the highest part there is an abundant spring, and the water is conducted by canals to irrigate the environs of the town, which abound in fruit and flower gardens. The principal church (the former cathedral and a heavy Gothic building), the great market place, the hospitals, the public library, which contains 10,000 volumes, the theatre, town-hall, exchange, gallery of paintings, Roman antiquities, and several pretty public walks, are the most noteworthy objects in Grasse. The present town is said to have originated in 583, from a colony of Sardinian Jews who had embraced Christianity. In the succeeding ages, the adjacent coasts being frequently ravaged by the Saracens, Grasse received great accessions to its population in emigrants from Frejus and Antibes.

GRASSES, a very extensive and important order of monocotyledonous plants, comprehending many of the most valuable pasture plants, all those which yield corn, such as wheat, barley, and maize, the sole source of sugar produced from the sugar cane, and the most fragrant of all plants in the form of Andropogons. Their structure is among the most simple of the perfect forms of vegetation; a stem clothed with alternate leaves, whose stalks are universally thin, and constituting as many sheaths to guard the young and rapidly growing shoots, a few rudimentary leaves collected at the ends of the branches of inflorescence, and constituting flowers, a very small number of stamens, and a single seed inclosed in a thin pericarp.

The flowers of wheat may be taken as typical of the floral structure of grasses. They are arranged two or more together in spikelets (*locustæ*), and the spikelets are placed in two rows along the top of the stalk, forming a *spike*. If we take a spikelet from about the middle of the spike we shall find at the base two scales, called the *outer glumes*, which inclose three to five flowers. Each flower is inclosed by two more scales, viz. a *flowering glume* and a *palea*. The flowering glume is slightly lower than the palea, and generally has an appendage called the *awn*. The palea has two side nerves but no midrib. Above the palea there are two minute scales, called *lodicules*, and then come three stamens and an ovary with two stigmas. In most grasses there are also empty glumes, either at the top or bottom of the spikelet, called sterile flowers.

Several botanists have undertaken the difficult task of classifying grasses. The latest revision is by Bentham in the "Genera Plantarum" of Bentham and Hooker. The following is a sketch of his arrangement into tribes:—

Series A, Paniceæ. The spikelets articulated with the pedicel below the glumes. A single fertile terminal flower, sometimes with a single male or sterile flower below it.

Tribe 1, Paniceæ. The spikelets hermaphrodite or more rarely unisexual, in spikes or panicles; the axis of the inflorescence not jointed. The flowering glume without an awn, the fruiting glume hardened. The type of this tribe is Panicum (millet).

Tribe 2, Maydeæ. Spikelets unisexual; the male flowers in the upper part of the inflorescences in spikes or panicles. Each fruiting spikelet falls away separately with the internode to which it is attached. The type is Zea (maize).

Tribe 3, Oryzeæ. Spikelets hermaphrodite or more rarely unisexual, in panicles or spikes, the axis of the inflorescence not jointed. The scale immediately under the single terminal perfect flower is keeled or one-nerved like the glumes (and therefore Bentham considers that it is the flowering glume, and that the palea is wanting). Type, Oryza (rice).

Tribe 4, Tristegineæ. Spikelets hermaphrodite, along the unjointed branches of a panicle, solitary or clustered. The fruiting glume and palea are thin, sometimes nearly transparent. The flowering glume has often a slender awn. Type, Melinis (or Tristegis).

Tribe 5, Zoysieæ. Spikelets hermaphrodite or some imperfect. The axis of the spike is not jointed, and the

spikelets disarticulate from it singly or in clusters. The flowering glume is membranaceous. Type, Zoysia.

Tribe 6, Andropogoneæ. Spikelets along the jointed axis of the spike or the branches of a panicle, in pairs or

glumes. The male or imper[illegible]y flowers, when present, are above the fertile one.

Tribe 7, Phalarideæ. Each spikelet with six glumes, the lowest pair empty below the articulation, the second pair above the articulation usually empty and small, the upper pair inclosing a terminal fertile flower. The sixth glume may be a palea, but as in Oryzeæ it is one-nerved or keeled. Type, Phalaris (canary-seed grass).

Tribe 8, Agrostеæ. A single flower in each spikelet, either apparently terminal or with a slight bristle-like continuation of the axis beyond it. Type, Agrostis (bent-grass).

Tribe 9, Isachneæ. A single or two equal flowers in each spikelet. Glumes generally without an awn. Axis of spikelet not produced beyond the flowers. Type, Isachne.

Tribe 10, Aveneæ. Spicules with two or several flowers, in panicles. The flowering glume with a twisted awn, either dorsal or terminal. Axis of spikelet generally produced. Type, Avena (oat).

Tribe 11, Chlorideæ. Spikelets with one or several flowers, sessile in two rows in unilateral spikes, the axis of which is neither jointed nor notched. Type, Chloris.

Tribe 12, Festuceæ. Spikelets with two or several perfect flowers, in panicles, more rarely racemes. Flowering glumes with or rarely without awns. Type, Festuca (fescue-grass).

Tribe 13, Hordeæ. Spikelets with one or several flowers. The spike simple, with its axis notched and often jointed. Spikelets sessile at each notch, one alone or several together. Type, Hordeum (barley).

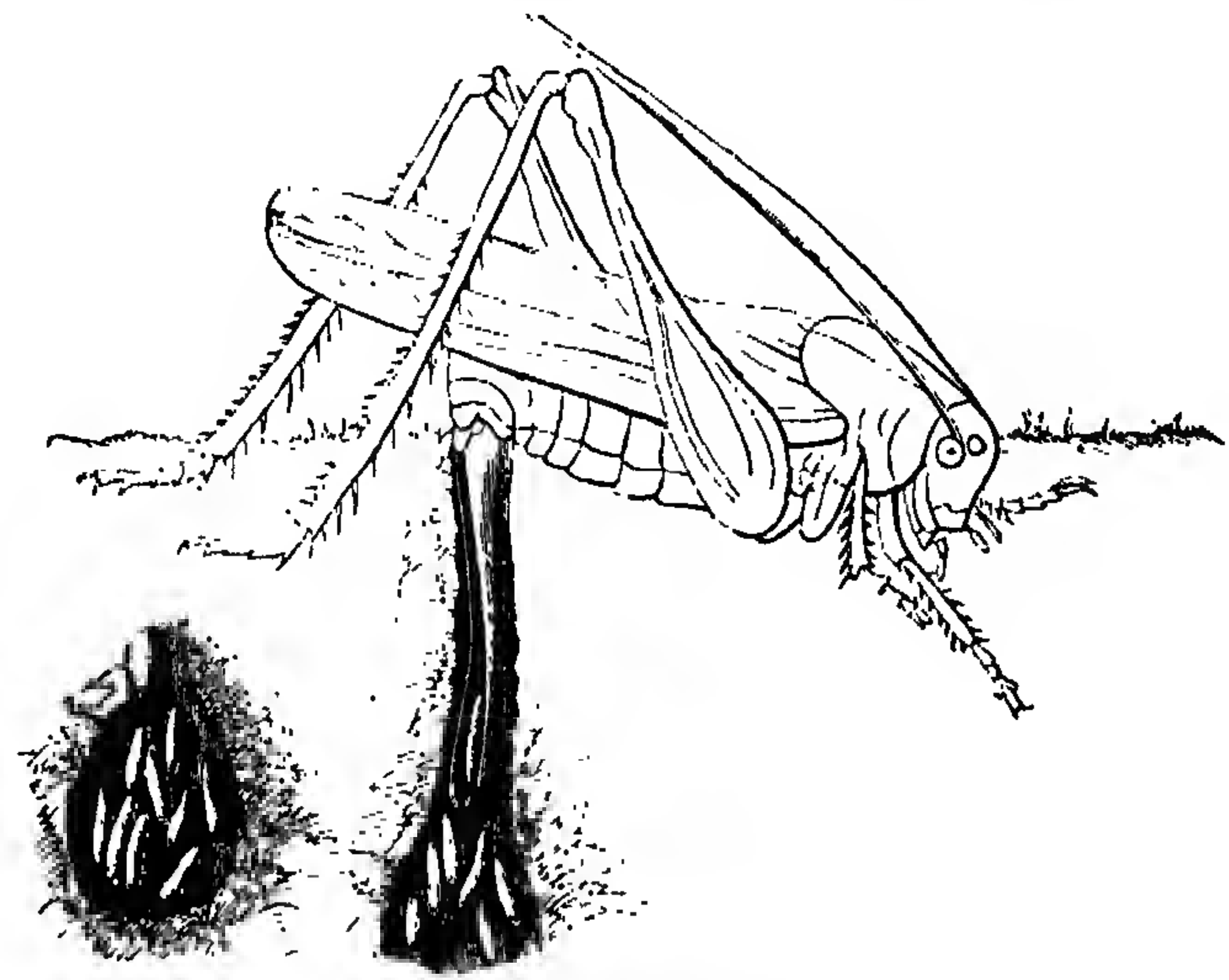
Tribe 14, Bambuseæ. Lofty grasses, often woody, at least at the base. Leaves flat. Spikelets with one or several flowers. Lodicules generally three. Stamens 3, 4, or more. Type, Bambusa (bamboo).

There is a great difference between the value of grasses for pasture; certain kinds suit meadows, others marshes, others upland fields, and others bleak and sterile hills, where they furnish valuable food for sheep; these kinds will not grow indiscriminately, or are not equally suitable for different soils and situations, and it is therefore essential for the husbandman that he should be capable of discriminating between them. Some indicate the quality of soil. The species of Dactylis, Holcus, and Bromus are inhabitants of sterile land; the Festucas and Alopecuri, of better soil; while various Poas and Cynosuri are found only in pasture-land of excellent quality. The single species *Lolium temulentum* is a deleterious species in the midst of harmless Lolia, and *Bromus purgans* and *Festuca quadridentata* afford similar instances of singular exception to ordinary rules.

Farmers divide them into artificial grasses and natural grasses, the former comprehending such as are cultivated for fodder, as clover; and the latter all true grasses.

GRASS'HOPPER, the name applied to many species of the families Locustidæ and Acridiidæ, of the order ORTHOPTERA. In these two families it is necessary to guard against confusing the scientific and the vulgar

acter of the antennæ, which in the Locustidæ are long and thread-like, and in the Acridiidæ short and stout. The Locustidæ have four joints to their tarsi, while the Acri-



Decticus verrucivorus.

diidæ have only three; in the latter family there is no projecting ovipositor. In both families the body is slender and the hind legs are long and powerful, adapted for leap-[illegible]. The Locustidæ are widely distributed. They feed chiefly on insects and larvæ. The wings are sometimes absent or rudimentary; the powers of flight are always feeble. Most of the Locustidæ are found on trees and bushes. The eggs are deposited by the female in holes in the ground made by her long ovipositor. The eggs are coated with a glutinous secretion. In these insects the metamorphosis is *incomplete*. The structure of the male is slightly different from that of the female. This difference is connected with the chirping or stridulation, for which the grasshopper is noted. In the male the wing-covers are furnished at the base with a round plate surrounded by strong, raised, and hard veins. The stridulation is caused by rubbing these together for the purpose of calling the female, which is destitute of this drum, and emits no sound.

The Great Green Grasshopper (*Locusta viridissima*), common in the south of England, measures over an inch in length. Of the same length is the species figured (*Decticus verrucivorus*), which is found in England, and is common over Europe. It received its specific name from Linnæus, from the Swedish peasants employing it to bite at the warts on their hands; the fluid ejected from the mouth is supposed to corrode the warts. See LOCUST.

GRASS'WRACK (Zostera), a genus of plants of the order NAIADEÆ, or pond-weed family. The Common Grasswrack (*Zostera marina*) is met with abundantly in estuaries, and in creeks on the shore into which the sea has access. It is much used for packing earthenware, and in the north of Europe for stuffing mattresses.

GRATIA'NUS, AUGUSTUS, eldest son of Valentinian I., succeeded after his father's death in 375 to a share of the Western Empire, having for his lot Gaul, Spain, and Britain; his brother, Valentinian II., then an infant five years of age, had Italy, Illyricum, and Africa, under the guardianship, however, of Gratian, who was in reality ruler of all the West. His uncle Valens had the Empire of the East. Gratian began his reign by punishing severely various prefects and other officers who had committed acts of oppression during his father's reign. At the same time, through some insidious charges, Count Theodosius, father of Theodosius the Great, and one of the most illustrious men of his age, was beheaded at Carthage. In the year 378 Valens perished in the battle of Adrianople against the Goths, and Gratian called to him young Theodosius, whom he sent against the Sarmatians, appointed him upon his victory as his colleague (in January, 379), and gave him the provinces of the East. Gratian returned to Italy, and resided for some time at Milan, where he became intimate with Bishop Ambrose, author of the "Te Deum" and other famous church songs. He was much harassed by the Germans and other tribes pressing on the frontiers of the empire.

In 383 a certain Maximus revolted in Britain, and was proclaimed emperor by the soldiers. He invaded Gaul, where he found numerous partisans. Gratian was defeated at Lyons, and taken and put to death by the partisans of Maximus. His remains were transferred to Milan, where they were interred. He was little more than twenty-four years of age, and had reigned about eight years. Ammianus Marcellinus, who is not liable to the charge of partiality towards the Christians, adds that had he lived longer he would have rivalled the best emperors of ancient Rome.

Gratian was also the name of a usurper in Britain, who assumed the purple in 407, but was almost at once murdered by his own troops. He was succeeded by another usurper named Constantine.

GRATIA'NUS, a Benedictine monk of the twelfth century, a native of Tuscany, according to some, and resident at Bologna. He is chiefly known for his collection of the canons or decretals of the church, which occupied him during twenty-four years, and which he published at Rome about the middle of the twelfth century. The collection, which has become known by the name of "Decretum Gratiani," was first printed at Mainz, in folio, 1472, and forms part of the "Corpus Juris Canonici." See Canon Law.

GRAT'TAN, HENRY, was born in Dublin in the year 1750. His father, a barrister and a Protestant, was recorder of Dublin, and also its representative in the Irish Parliament. Young Grattan entered at the usual age as a fellow-commoner at Trinity College, Dublin; and having here distinguished himself considerably he proceeded to London, after taking his degree, for the purpose of keeping terms at the Middle Temple, and of studying law. He was called to the Irish bar in 1772. In 1775 he was returned to the Irish Parliament, under Lord Charlemont's auspices, as representative of the borough of Charlemont.

In Parliament he at once joined the ranks of the opposition. One of the first fruits of Grattan's zeal and eloquence was the partial throwing open of Irish commerce. Subsequently, in 1780, he moved in the Irish Parliament the memorable resolution "that the king's most excellent Majesty and the Lords and Commons of Ireland are the only power competent to make laws to bind Ireland."

Such was the pitch of popularity to which Grattan had now attained, that the Irish Parliament voted him the sum of £50,000 "as a testimony of the national gratitude for great national services." In consequence of the declaration of the rights of the Irish Parliament, a negotiation was set on foot for the repeal of the Act (6 Geo. I.) by which the British legislature declared its right to bind Ireland by British statutes. When the repeal of this Act was brought forward in England Mr. Flood moved in the Irish Parliament for leave to bring in a bill for declaring the exclusive right of the Irish Parliament to make laws for Ireland. Grattan contended that the simple repeal of the Act was sufficient. Mr. Flood's bill was thrown out by a large majority of the House; but the sympathies of the nation were with Mr. Flood, and Grattan now for a time undeservedly lost much of his well-earned popularity.

His opposition, however, in 1785 to the propositions regarding the trade between Great Britain and Ireland, moved by Mr. Orde in the Irish Parliament, restored him to his lost place in the affections of his countrymen. One of these propositions was to the effect that the Irish Parliament should from time to time adopt and enact all such Acts of the British Parliament as should relate to the regulation or management of her commerce. Owing principally to Grattan's efforts the measure was relinquished. He went on to secure a continuance of his now regained popularity by the introduction of a measure for getting rid of tithes, which was, however, rejected. In 1790 Grattan was returned to Parliament for Dublin.

In the Parliament which now met, the question of Catholic emancipation being raised, Grattan appeared of course as the friend of religious liberty. He thereby offended his new constituents. At the same time he found himself unable to stem that movement which, originating with the recall of Lord Fitzwilliam, terminated in the rebellion of 1798, and he therefore voluntarily retired from Parliament. He was afterwards returned for Wicklow, for the express purpose of opposing the Union. The Union was carried, and in 1805 he entered the imperial Parliament as member for the borough of Malton. The next year he was returned for Dublin. Preserving in his new position the reputation which he had before acquired for eloquence, he also adhered inflexibly to those principles of toleration and popular government of which in Ireland he had been the champion. He lost no opportunity of advocating the Catholic claims. He may be said, indeed, to have died in the cause of Catholic emancipation. He had undertaken to present a petition from the Irish Catholics, and to support it in Parliament, notwithstanding the remonstrances of his friends that the exertion would be incompatible with his declining health. "I should be happy," he replied to those remonstrances, "to die in the discharge of my duty." He had scarcely arrived in London with the petition when his debility greatly increased. He died on the 14th of May, 1820, at the age of seventy. His remains were interred in Westminster Abbey. As in public life he was honest and consistent, so in his private was he irreproachable. His speeches were collected and published by his son, in four volumes 8vo, in 1821. A statue to his memory was erected in Dublin in 1876.

GRAUN, CARL HEINRICH, was born in Saxony in 1701. He was a singer of great ability, but it is as a composer of church music that he is best known. He was much patronized by Frederick the Great, and died in 1759. Graun was a very voluminous composer, but most of his works are now forgotten. He wrote no less than twenty-seven operas, and was universally held to excel in opera all composers of the time except Hasse. Airs from them are still occasionally heard. His short oratorio, "Der Tod Jesu" (The Death of Christ), possesses very considerable merit, holding the place in the affections of Germans which the "Messiah" does in those of Englishmen, and his "Te Deum" is a work of great invention, beauty, and grandeur.

GRA'VE (two syllables), usually reckoned the slowest time in music, and used only in circumstances of the greatest solemnity, as, for instance, the opening of the "Messiah." It is a term indicating character quite as much as pace, or perhaps rather character *through* pace. It is rarely used. Mendelssohn metronomes it in "Elijah"

as 60 = 𝅗𝅥, and in "St. Paul" as 66 = ♩. Although *grave* is certainly slower in effect than *largo* or *adagio*, yet in several cases it is difficult to say which of the three terms is preferable. See also the remarks under ADAGIO.

GRAV'EL is the term used to designate accumulations of loose rounded water-worn detritus. The fragments, varying in size from that of a walnut downwards, are usually quartz or some hard crystalline rock capable of withstanding a grinding and abrading action. Gravels in geology may be river gravels, estuarine gravels, &c., or named according to components, limestone, quartz, &c. In the older formations they form conglomerates, pudding stones, &c.

GRAV'EL is the name commonly given to a complaint that is marked by the passage of gritty particles with the urine. There are several varieties of gravel, but the most common form is that made up of lithic acid crystals, and which has the appearance when voided of Cayenne pepper. The urine itself is generally clear, but of a dark golden or coppery colour, and having a distinctly acid reaction. Sometimes the passage of these crystals gives rise to no discomfort, and is compatible with a good state of health; but more often it is attended with a disturbance of function, both local and general. The local symptoms consist of a dull aching pain in the loins, twinging pains in the limbs, a sense of heat and irritation at the neck of the bladder, and a painful sensation during and after the passage of the urine, which is sometimes marked with a slight tinge of blood. The general symptoms are such as are common in dyspepsia—headache, heartburn, flatulence, and a general feeling of uneasiness and discomfort. The causes of this complaint are also such as commonly produce indigestion, and it is frequently brought on by want of proper exercise and the use of rich food and alcoholic liquors. It may, however, arise from climatic influences or impure drinking water, while there can be no doubt that a tendency to the formation of gravel is hereditary.

The presence of gravel is not to be regarded as an evidence of kidney disease, but as a rule it may be taken as a sign that the liver is inactive, and the treatment must be directed to that organ. Great care must be taken with respect to the diet—sugar, fat, butter, and cream being as far as possible avoided, and animal food and fermented liquors taken only in strict moderation. The medicines that are most useful are the natural mineral waters which act upon the digestive organs, such as those of Friedrichsthal, Pullna, Marienbad, Vichy, and Vals. Sometimes pure water is used with advantage, a tumbler being taken every night on retiring to rest, and another about two hours before dinner. Blue pill is frequently an effective remedy, but this is a drug that must be used with discretion, and which is unsuitable for continued use. The most important point in the treatment of gravel is certainly that of attention to diet and exercise.

GRAVELINES, a strongly fortified seaport town of France, in the department of Nord, 12 miles W. from Dunkirk, built in a marshy spot at the mouth of the Aa. It has a lighthouse, and 8063 inhabitants. The town is pretty well built, the arsenal being the most remarkable object. The fortifications render the town impregnable towards the sea; on the land side it may be surrounded with water at pleasure. The principal articles of trade are wine, spirits, eggs, salt, timber, salt-fish, refined sugar, beer, &c. Vessels are fitted out for the herring, cod, and mackerel fisheries. The town is protected from the sea by *dunes* or sand-hills. It contains an arsenal, military magazine, and military hospital. It was off Gravelines that the Spanish Armada, driven out of Calais by fire-ships, was defeated by the English in 1588.

GRAVELOTTE, near Metz, formerly a French village, but now included in Germany, has given its name to one of the most sanguinary battles of the whole Franco-German war of 1870–71. On 18th August the French lines stretched along a commanding position on the hills from Metz to St. Privat. From their position on a line of hills between Rezonville and Gravelotte, the Prussians, by twelve o'clock, had pushed forward till their line extended considerably on either side of Gravelotte. From ten o'clock till twelve the battle had been mainly an artillery duel, but a desperate struggle now ensued, during which the fortune of the day was long in suspense. It was not till nightfall that the Germans, by dint of repeated charges, gained the slopes over Gravelotte; and the right of the French having been outflanked, they retired under cover of Metz. The carnage was unexampled, the French being said to have lost 19,000, and the Germans 25,000. The King of Prussia, who commanded in person, had with him the first and second German armies, while the French army, which included the Imperial Guard, was commanded by Marshal Bazaine.

GRAVER or **BURIN,** the name given to the tool chiefly used in line engraving. It consists of a lozenge-shaped point of hard steel fitted into a short handle, and in making the lines it is pushed in the direction required, the handle being held at a slight angle to the plane of the plate to be engraved.

GRAVESEND, a market-town and municipal and parliamentary borough of England, in the county of Kent, situated on the south bank of the Thames, 24 miles from London by the South-eastern Railway. It is the outpost and boundary of the port of London. Outward-bound ships anchor here to receive their bills of lading, take passengers on board, and for inspection by the emigrant officers; while inward bound vessels are boarded here by the revenue officers, and receive a river pilot. Colliers bound to London stay here till directed to proceed up the river by the city official. Gravesend is consequently a great pilot station, has a large number of watermen, a custom-house, and a guard-ship, and seems to be increasing in favour with the great steamship companies as a starting-point. It has a free school, almshouses, a battery on its eastern side, a custom-house, numerous baths, libraries, &c. Steamboats run to London in two hours, and one of the earliest passenger steamers (the *Kent*) plied from Gravesend to the metropolis in 1829. There is a steam ferry across the Thames to the Tilbury station of the London and Southend Railway. Gravesend is a noted resort for holiday-makers from London, who flock here and to Rosherville and Springhead, which are both in the neighbourhood. There are numerous places of worship, national, infant, and other schools, a free grammar-school, almshouses, town-hall, assembly-rooms, &c. New barracks were erected in 1862, and from that time considerable sums have been expended on fortifications at Gravesend. The municipal borough is governed by six aldermen and eighteen councillors. The town was created a parliamentary borough by the Reform Act of 1867, and returns one member. The population in 1881 was 31,283, and the number of voters is about 4,200. Cobham Hall, about 4 miles S.E., the residence of the Earl of Darnley, is a noble Tudor mansion in a fine park, with a celebrated collection of pictures.

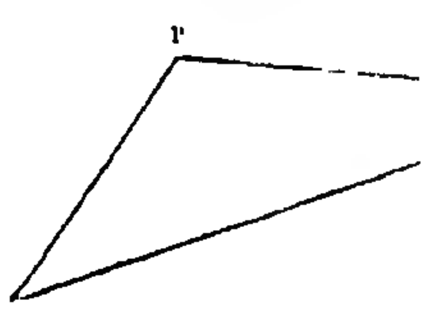
The town is called Grevesham in Domesday Book, and its later name was Greves-end, supposed to be derived from the Saxon *gerefa*, or German *greve*, ruler, and *ende*, boundary, because the town was the limit of the ancient portreve's authority. The high bailiff was called the portreve in the fourteenth century. In the time of Richard II. the town was burnt by the French, and many of the inhabitants carried into captivity. In earlier days it was even a more important starting-point than it is now, for Cabot and Frobisher both set sail from here on their voyage of discovery.

GRAVITATION. We refer to SOLAR SYSTEM for an account of the laws of Kepler, by which the movements-

of the planets are regulated. At the time of their discovery Kepler's laws were merely empirical results deduced from a discussion of the observations of the planets. It was Newton who showed that they are necessary consequences of the grand law of nature known as the law of gravitation. The first law of motion states that a body once set moving in any direction will continue to move on with unalterable velocity for ever in the same direction, unless some force intervene. If, then, we find that a body is moving in a path which is not straight, or with a velocity which is not uniform, it follows that there must be some force in action. The movements of the planets are neither straight nor uniform; we must therefore admit that some force is constantly acting on the planets, and it remains to be discovered at each movement the direction and the intensity of that force.

The first point to be proved is deduced from Kepler's second law. If the planets describe equal areas in equal times, then the force which acts upon the planets must pass through the sun's centre. This can be readily shown to be a consequence of the laws of motion. Let the direction and magnitude of the velocity of a body be represented by

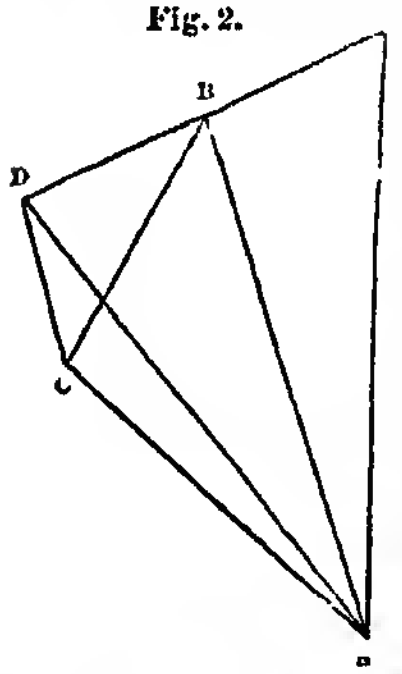
Fig. 1.



the line A P, fig. 1. Suppose that by the sudden application of a force the velocity is so changed that it becomes parallel and proportional to A Q, then we know from the second law of motion that the magnitude and direction of the force are respectively proportional and parallel to P Q. The curvilinear path of a planet around the sun may be regarded as a polygon, consisting of infinitely small rectilinear sides, each of them having a length proportional to the velocity at that point.

Let A B and B C (fig. 2) be two of the consecutive sides of this polygon, while S is the sun. The planet may be regarded as moving along A B with a certain uniform velocity. It then moves along B C with a velocity also uniform, though slightly different from that along A B. As the lengths A B and B C are proportional to the velocities, each of the sides of the polygon will be traversed in the same time. Produce A B to D, making D B equal to B A, join D C, then the force acting on the planet must be parallel to D C, because the planet's velocity has been changed from A B to B C. But from Kepler's second law the area A S B is equal to the area B S C, and as A B is equal D B, it follows that the area A S B is equal to D B S. Hence the area of D B S is equal to that of B S C, and therefore by a well-known proposition in Euclid the line D C is parallel to B S; but D C is parallel to the force acting on the planet, therefore the line of the force must be B S, or in other words, the force acting on the planet is constantly directed to the sun. We thus see that the direction of the force acting on the planet at each corner of the polygon points towards the centre of the sun. But the number of sides

Fig. 2.



of the polygon being indefinitely great, we find that the planet must at each position be acted upon by a force directed towards the centre of the sun. Thus it was that Kepler's discovery of equal areas in equal times led Newton to infer that the force which acts upon the planets must be directed towards the sun. Newton also proved the converse to be true. He showed that when the motion of a body takes place under the action of any force directed to a fixed point, the radius of the moving body will sweep over equal areas in equal times. But Newton went further; he not only ascertained the direction of the force, but he made the supremely important discovery of the law according to which the intensity of the force varies at the different positions of the planet. To solve this Newton had recourse to the two remaining laws of Kepler. The third of these laws asserts that the squares of the periodic times of two planets around the sun are in the same ratio as the cubes of their mean distances. There is here no direct reference to the eccentricities of the orbits, so we may for the purpose of considering this law assume that the orbits of the two planets are circular. Such an assumption is not excluded by the first law of Kepler. A circle is merely an extreme form of ellipse where the eccentricity is zero. In the case of a planet revolving in a circular orbit, the second law, which asserts the description of equal areas in equal times, requires that the velocity shall be uniform.

Suppose, then, the case of two planets which revolve around the sun in orbits which are circular. Let the radii of their orbits be denoted by a and b, and the times in which they revolve by x and y, then the third law of Kepler expresses the proportion:

$$x^2 : y^2 :: a^3 : b^3.$$

We know from the principles of dynamics that if a body be revolving in a circle of radius a and in a time x, there must be a force tending towards the centre of the circle, whose magnitude is proportional to $a \div x^2$.

Let F and F′ be the two forces, then—

$$\mathrm{F} : \mathrm{F}' :: \frac{a}{x^2} : \frac{b}{y^2}$$

$$\frac{\mathrm{F}}{\mathrm{F}'} = \frac{y^2}{x^2} \cdot \frac{a}{b};$$

$$\text{but} \qquad \frac{y^2}{x^2} = \frac{b^3}{a^3},$$

$$\text{whence} \qquad \frac{\mathrm{F}}{\mathrm{F}'} = \frac{b^2}{a^2},$$

$$\mathrm{F} : \mathrm{F}' :: \frac{1}{a^2} : \frac{1}{b^2}.$$

We hence deduce the important result that when two planets are revolving around the sun in circular orbits, the intensities of the forces vary inversely as the squares of the distances. Newton further showed that even if a planet move in an ellipse of any eccentricity, provided only that the sun is in the focus, and that equal areas are described in equal times, the planet must still be acted upon by a force varying according to the same law; hence we can assert that *each planet is attracted towards the sun by a force which varies inversely as the square of the distance from the sun.*

In the same manner as the planets describe ellipses around the sun in virtue of the sun's attraction, so the moon describes an ellipse around the earth, and the satellites of other planets describe ellipses around their primaries. So far as we know it is generally true that every body in the universe attracts every other body with a force varying inversely as the square of their distances. The evidence on this matter is not restricted to the solar system. Certain

of the double stars perform movements which can be readily explained by the supposition that they are mutually attracted by gravitation. We have, however, no means of observing whether the stars actually attract other stars at a very great distance. We do not know, for instance, whether Sirius attracts the Pole-star, or whether either of them attracts the sun. Assuming the law to hold good we can calculate the intensity of the attraction between a star and the sun. The result is so minute as to hopelessly baffle the most delicate methods of measurement.

It remains to be seen how the intensity of the attraction between two bodies is affected by their masses. If the mass of either body be doubled the attraction is doubled. If the masses of both bodies be doubled the attraction is quadrupled. Hence it follows that the intensity of gravitation is proportional to the product of the masses, so that the true expression for the attraction between the masses m and m', separated by the distance r, is

$$c\, m\, m' \div r^2.$$

The coefficient c depends upon the intrinsic efficiency of the attraction of gravitation. It may be defined as the number of units of force in the attraction between two units of mass separated by the unit of distance. It will be interesting to determine c in our ordinary units.

The earth, the moon, and the planets are all bodies of the most stupendous mass, and as the movements of these mighty bodies are controlled by gravitation, we are naturally apt to suppose that gravitation must be a force of gigantic efficiency. It is no doubt true that the attraction between the earth and the sun is a force of stupendous intensity, but that is not due to the intrinsic magnitude of gravitation. Gravitation itself is but a small force compared with our ordinary notions, but the gravitation between the masses being proportional, not only to the intrinsic efficiency of the force, but to the product of the two masses, it may happen that the masses are so transcendent that their product, when used as a factor, exalts a very weak force indeed into one of astounding magnitude. When we associate gravitation with masses of manageable dimensions, it is surprising to find that the mighty power which controls the solar system is at once reduced to such an extent that the most refined arrangements in the cabinet of the experimentalist barely suffice to enable the force to be measured. Should it be desired to represent gravitation as a force of moderate intensity existing between the masses at a distance commensurate with ordinary conceptions, we must choose our masses, not indeed so great as those of the celestial bodies, but still vastly greater than those with which daily experience makes us familiar.

Conceive a gigantic globe made of solid cast-iron and 53 yards in diameter. This is to be one of our attracting masses, and it should weigh 415,000 tons. The other attracting mass is to be a twin sphere, and both are equal in every respect. Let these spheres be placed at a distance of a mile from centre to centre (fig. 3); let them be

Fig. 3.

1760 yards.

left each initially at rest, and let us suppose the attraction of the earth and every other source of disturbance to be swept away. Then the spheres, thus isolated and poised in space, will each be acted upon by one force, and one alone. The force on each sphere is the attraction of the other. That force is exerted in the line joining the two spheres, and in virtue of it the two spheres will tend to draw in together. But before the motion commences we wish to measure the intensity of the force by which the two spheres are urged together. Imagine each of the spheres held back by a cord, and the strain on each of these cords to be tested. Considering the gigantic masses which are to be held asunder, we might suppose that the force necessary to restrain them would be also of colossal dimensions, but this is not the case. Each of the cords would no doubt be strained, but only with a force of a single pound. In other words, if the cords were strong enough to support a pound weight on the earth's surface, they would be strong enough to counteract the gravitation between these mighty globes of solid iron a mile apart.

The cords being removed the force of gravitation commences to produce motion. The inertia of the vast globes is, however, so great that the feeble force of a pound applied to each could only produce a very small effect. At first it would take a microscope to show that the globes were in motion. Twenty-six minutes must elapse before the mile has been decreased by a single inch, and a foot will not have been accomplished in less than an hour and a half. But the velocity gradually increases. In the first place the approaching spheres retain at each instant all the velocity they have acquired since the commencement of the motion. In the second place, as the distance decreases the mutual attraction augments. By the time the distance has been lessened to half a mile the attractive force has been increased fourfold. Thus the velocity of approach receives augmentation at an increasing rate, but even the whole of a day does not suffice for the attraction to draw the two spheres together. Three days and three nights must pass, and the fourth day must be well-nigh completed before the collision will take place. At that moment the two spheres are moving with such rapidity that the last foot and a half of the journey is accomplished in one second of time. The final velocity of the two spheres is thus about a mile an hour.

The attraction of gravitation may be compared and contrasted with the familiar phenomenon of magnetic attraction. A magnet attracts a piece of iron with a force which increases as the two bodies approach. It is probable that besides the magnetic attraction the two bodies are also drawn together by gravitation, but the gravitation is excessively small compared with the magnetic attraction. On the other hand, the magnetic attraction is confined to but very few bodies—it is not indeed conspicuous in any body except iron, while gravitation appears to be absolutely universal. Two masses of lead, each weighing a ton, and placed at a distance of 10 feet from each other, are attracted by a certain force of gravitation. If we change one or both of the tons of lead for a ton of iron or timber or water, or any other substance, it would seem that the attraction between the two masses will be absolutely unaltered. Gravitation depends only upon the masses of the bodies which are concerned, and not upon their material nature.

The movements of the planets around the sun are to a certain extent deranged by their mutual attraction. The mass of the sun is so great, and it exceeds the masses of the planets in such an enormous ratio, that the planets are of course mainly subordinated to the attraction of the sun; but when we look into the matter more carefully, especially when observations made at distant intervals are compared together, it is found that the movements of the planets deviate slightly from Kepler's laws. The orbits do not constantly remain in the same plane. They are not

accurately ellipses, nor is the law of equal description of areas in equal times accurately fulfilled. The theory of universal gravitation renders an account of these irregularities. Indeed they are a necessary consequence, if the doctrine of universal gravitation be true. According to that theory not only must the sun attract the planets and the planets attract the sun, but the planets must attract each other, and it is in the mutual attractions of these planets that an explanation of the irregularities is to be sought.

It is, however, very remarkable that the mutual perturbations of the planets are not competent seriously to derange the adjustments of the solar system. It has been proved that the length of the axis major of each planet's orbit will remain constant notwithstanding all perturbations. This is a guarantee that the mean distance of the planet from the sun shall remain unchanged—a guarantee of the most vital importance to a planet like our earth, which has inhabitants who are dependent upon the sun for every day of their lives. The eccentricities of the orbits of the planets are not, however, constant, they are deranged by the perturbations; but it can be shown that even the greatest fluctuations of the eccentricities can never be considerable, can never reach an amount calculated to imperil our system. So also the planes in which the planets move undergo slight fluctuations, but they merely oscillate to and fro about a mean position. There can be no injury to the system from this source either.

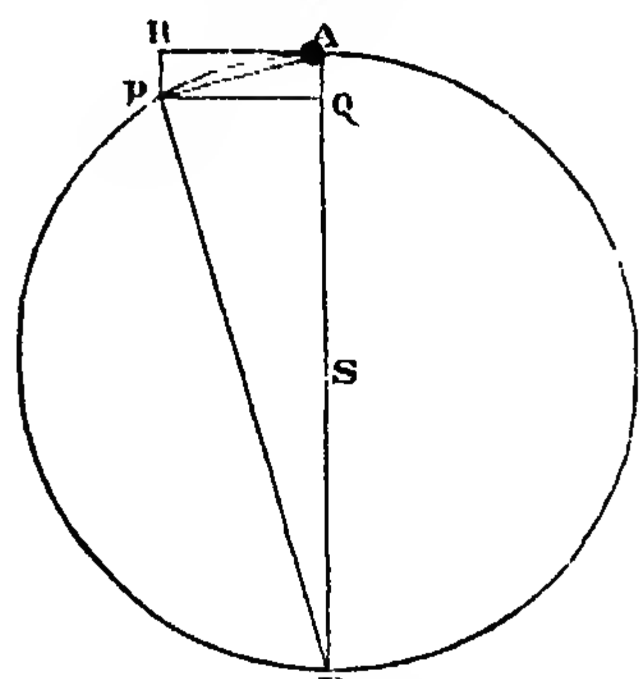
As the astronomer can make optical discoveries with his telescope, so he is able to use the law of gravitation as an instrument of research with which to probe out the secrets of the solar system. There is no more wondrous problem than that of actually placing a distant celestial body in the weighing scales and determining its weight in millions of tons. Yet the law of gravitation, when used to interpret certain observations, will tell us the masses of many of the celestial bodies. Let us, for instance, compare together the mass of our earth and the mass of the sun. It is proved by observations at the surface of the earth that a body allowed to fall freely will, in consequence of the earth's attraction, fall 16·1 feet in one second. As the efficiency of the earth's attraction decreases in the inverse square of the distance from the earth's centre, and as the distance of the sun is 23,300 radii of the earth, it follows that at the distance of the sun the earth's attraction would cause a body to fall in one second through a distance of $\frac{16{\cdot}1}{(23{,}300)^2}$ feet. This distance is proportional to the mass of the earth, and if we can find out how far the sun will cause a body to fall in one second at a distance of 23,300 terrestrial radii, the ratio of these two falls will be equal to the ratio of the masses of the sun and the earth. The annual movement of the earth gives us the means of calculating how far a body at the earth's distance falls in towards the sun in one second. The earth would move off in a tangent to its actual path if the attraction of the sun were suspended; it follows that the deflection of the earth from the tangent in one second is the quantity of which we are in search. Let the earth move from A to P (fig. 4) in one second. Then if A R be the tangent at A, the line P R expresses the distance through which the earth has fallen in one second in towards the sun's centre. Let fall P Q perpendicular on A B, then we have $PR = AQ$ and $AP^2 = AQ \cdot AB$; but we have $AP = 18{\cdot}3$ miles and $AB = 185{,}000{,}000$ miles, whence $AQ = \frac{(18{\cdot}3)^2}{185{,}000{,}000}$ miles, or $\frac{(18{\cdot}3)^2}{185{,}000{,}000} \times 5280$ feet. We thus see that the ratio of the sun's mass to the earth must be

$$\frac{(18{\cdot}3)^2 \times 5280 \times (23{,}300)^2}{185{,}000{,}000 \times 16{\cdot}1} = 322{,}000.$$

There is but little difficulty in finding the mass of a planet which, like Mars, Jupiter, Saturn, Uranus, or Neptune, is attended by one or more satellites. From measurements of the satellite we determine the distance through which the satellite falls in toward its primary at each second, and from the movements of the planet round the sun the distance the planet falls towards the sun each second is determined, whence we can deduce the ratio of the mass of the planet to the mass of the sun.

In the case of planets which, like Venus and Mercury, are not attended by any satellites hitherto detected, the

Fig. 4.



determination of the masses is a more difficult question. We are then obliged to resort to the perturbations which these planets produce on the movements of other bodies belonging to the solar system. The theoretical expressions of these perturbations involve the mass of the disturbing body; the coefficients of these expressions being known, and their total amount being derived from observations, the value of the unknown mass is ascertained.

The gravitation at the surface of a celestial body due to its attraction depends partly upon the mass of the body and partly upon its radius. When we know the mass and the radius we are able to compute the gravitation. We thus find that on the surface of the sun the gravitation has an intensity almost twenty-seven times greater than the gravitation on the surface of the earth. On the surface of the sun a body would fall in one second a distance of $16{\cdot}1 \times 27$ feet, and the effort of raising a pound weight on the sun would require the same muscular exertion as would suffice to raise a weight of 27 lbs. on the earth.

GRAVITY, CENTRE OF, is that point at which all the weight of a mass might be collected without disturbing the equilibrium of any system of which the mass forms a part, or the point existing in every body of whatever form on which the mass will rest, however placed, in equilibrium. When a body is suspended by a string and allowed to find its position of rest, the centre of gravity is in the line of continuation of the string. If, then, a body be suspended successively at two different points, and if the lines in which the strings produced would cut through the body can be conveniently determined, the centre of gravity is the point of intersection of the two lines. This process is very easy in the case of a thin flat surface, and the approximation is quite sufficient for practical purposes.

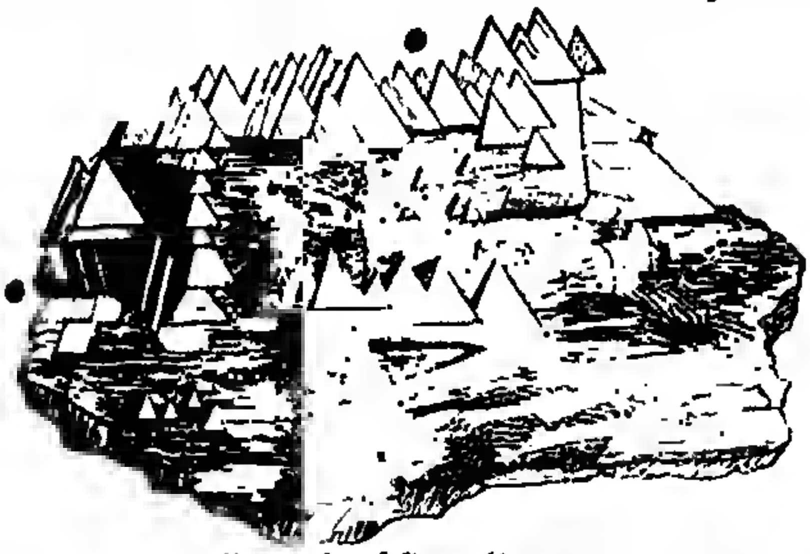
GRAVITY, SPECIFIC. See SPECIFIC GRAVITY.

GRAY ANTIMONY is the sulphide of antimony (Sb_2S_3), antimonite or STIBNITE; it has received this name from its colour when finely crystalline. It is an important source of antimony, but the most injurious impurity, and that most commonly present, is lead.

GRAY CHALK is a lithological subdivision of the CHALK formation, of which it forms the lower portion

It has a somewhat grayish tint, and rests on the chalk marl. It is well exposed in the cliffs of Kent near Folkestone, and is about 200 feet thick. Some of the characteristic fossils are *Holaster subglobatus*, *Belemnites plenus*, *Ammonites varians*, *Discoidea cylindrica*, and *Coniaster mosaicus*.

GRAY COPPER is the name usually employed by miners for the complex copper ore FAHLERZ or tetrahedrite, in contradistinction to yellow copper, which is applied to CHALCOPYRITE or copper pyrites. The essential composition of this ore is sulphide of copper and antimony ($4Cu_2S.Sb_2S_3$), but iron, zinc, silver, gold, mercury, and several other minerals often are present as



Crystals of Gray Copper.

accessories. It has a hardness of from 3 to 4·5, and specific gravity from 4·5 to 5·1. It crystallizes in the cubic system, usually as tetrahedra modified and twinned; it also occurs compact. A common grouping of the crystals is shown in the annexed cut.

GRAY WETH'ERS are those angular blocks of silicious quartz, grit, and sandstone that lie scattered over the chalk plains of Wiltshire and Dorsetshire. They have been derived from and are some of the last remnants of the harder portions of the Eocene strata that formerly lay above the chalk in this district, but have long since been denuded away.

GRAY, THOMAS, an English poet, born in Cornhill, 26th December, 1716, was the son of a citizen and money-scrivener in London. He was educated at Eton, where he made the acquaintance of West and Horace Walpole, with the latter of whom he removed in the autumn of 1736 to Cambridge. He entered at Peter House, and continued to reside there till September, 1738, when he left without a degree.

Gray had intended on leaving Cambridge to devote himself to the study of the law, and after his return from a tour on the Continent he resided at Cambridge, and took the degree of B.C.L. The "Ode to Spring" was written in 1742; and in the autumn of the same year were written the "Ode on a Distant Prospect of Eton College," and the "Hymn to Adversity." The "Elegy in a Country Churchyard" was also commenced at this period, but not finished till seven years afterwards. In the meanwhile the "Ode to Eton College" had been published (being the first of Gray's publications) in 1747, and little notice had been taken of it. The "Elegy," published in 1749, rapidly obtained an extensive popularity.

In March, 1753, Gray lost his mother. During the three years following Horace Walpole observes that Gray was "in flower." The "Ode on the Progress of Poetry" and the "Bard" were then written. In 1756 Gray removed to Pembroke Hall. On the death of Cibber in 1757 he was offered the laureateship by the Duke of Devonshire, which he declined. In 1768 he was appointed to the professorship of modern history at Cambridge. In the autumn of 1770 he made a tour in Wales, though he had been very unwell in the spring; and after suffering for some months from a violent cough and great depression of spirits, he was suddenly seized, on 24th July, 1771, with an attack of the gout in the stomach, which caused his death on the 30th of the same month.

Gray wrote little, but the little that he wrote was written with great care. Thus his poems, with the exception of one or two of a humorous character, are all much elaborated; and it follows that the quality which they chiefly display is taste. His "Ode on the Death of a Favourite Cat," the "Long Story," and many passages of his letters, show that he possessed considerable powers of humour. The best life of Gray yet written is that contained in the series of "Lives of English Men of Letters" by Mr. Gosse.

GRAY'S INN, one of the four Inns of Court which have the exclusive right of calling persons to the English bar, or rather to the degree of barrister-at-law. It is governed by a committee, called benchers, who are generally queen's counsel or senior counsel, and is situated in Gray's Inn Lane, London.

GRAY'LING (*Thymallus vulgaris*) is a fish of the family Salmonidæ, found in many British streams, and ranging over North and Central Europe. The genus Thymallus is distinguished from the genus Coregonus, which contains the Gwyniad, Vendace, Pollan, &c., chiefly by its long many-rayed dorsal fin. The grayling is about 10 inches in length. The back and sides are yellowish-brown, marked with longitudinal dusky streaks. The grayling inhabits streams with rocky or gravelly bottoms. Its food consists of flies and small molluscs; it is angled for in the same way as the trout. It is in the best condition in October or November, when it is much esteemed for the table. When first taken it has an odour like that of wild thyme. Four other species of graylings are known, none of which are British.

GRAY'WACKE (Ger. *grauwacke*) is a lithological term for certain GRITS and BRECCIAS that occur chiefly in the palæozoic formations. This variety of CLASTIC ROCK consists of rounded or angular grains of quartz, felspar, or other rock cemented together by a silicious, felspathic, argillaceous, or calcareous cement. Some fine-grained varieties have a fissile structure, and are termed graywacke slate.

GREASE, the name applied to all oily or fatty matters, but especially to those which are too impure for candle-making or other refined manufactures. It is chiefly used for lubricating machinery, wheels, &c. A great quantity is exported from South America, being the fat of horses and other animals killed for the sake of their hides, bones, and hair. This kind is called, in commercial parlance, mares' grease. Grease suitable for ordinary carts and waggons is made chiefly of tallow or train-oil and tar, with or without a little water. A species containing resin-oil is made largely in the Tyne district in connection with manufactures which leave resin as a cheap residue.

The grease used for lubricating the wheels of railway carriages is of a superior kind, being made of palm-oil or cocoa-nut oil, with which is mixed some soda, to prevent it from melting too rapidly, as it would otherwise do from the excessive friction of the wheels. Bears' grease is a composition sold by perfumers, made for the most part of marrow, lard, or fat, profusely scented. The genuine fat of the bear is, as a matter of course, very scarce, and its virtues are probably chiefly imaginary.

GREAT BEAR and **LITTLE BEAR**. The Great Bear (*Ursa Major*) is one of the finest of the northern constellations. The seven great stars belonging to it have for centuries been called in England the *Ceorl's Wain* (countryman's waggon), which later days have corrupted into Charles' Wain. Says the carter in Shakspeare, "An't be not four by the day, I'll be hanged. Charles' Wain is over the new chimney," &c. ("Henry IV.," Part I. ii. 1). The Butcher's Cleaver, the Plough, &c., are also names of this star group, and in America the

Dipper. Aratus mentions that the Greek sailors were in the habit of navigating by night by this constellation because of its nearness to the pole, till the Phœnicians pointed out the much greater nearness of the Little Bear containing the Pole-star. Alpha of the series is a variable double star, Delta is a waning star, having been in historical times fully as bright as its companions, though now so much duller. The Great Bear, under its Latin name of *Ursa Major*, will be found in our Plate CONSTELLATIONS, Northern Hemisphere, extending across the equinoctial colure on the left hand of the plate. The seven Charles' Wain stars will be observed to form but a small part of the whole constellation. The middle star (ζ) of the three tail-stars of the bear, *i.e.* the three horses of the Wain, was called by the Arabians *Mizar*, and near it is a little companion star whose Arabic name is *Alcor*, and which used by them as a test of keen sight. It may have grown bigge then, for it is now visible to most persons with the naked eye. The old English name for it is "Jack by the middle horse." The origin of the name *Bear* is not known. It is presumable that to the Chaldeans who named the star groups this group anciently presented a bear-like appearance, and got named accordingly. The present figure is intensely absurd, for the more modern astronomers have made a fine feature of the tail out of three of the main stars, though, of course, had they ever seen a bear they would have known him to be a tailless animal. However, both the astronomical bears as now figured rejoice in waving bushy tails. The variability in the figures formed by the stars, so that the groups once (presumably) such natural and striking representatives of

Charles' Wain as it now is (the arrows showing the directions in which the stars are moving among themselves).

The same, as it was 100,000 years ago, if the stars moved at the same rate.

The same, as it will be 100,000 years hence, if the stars move at the same rate.

the objects they are named from, are now far from recognizable, arises from the various independent motions of the separate stars. Proctor ("Easy Star Lessons," Lond. 1881) has observed very accurately the "proper motions" of the seven stars of the Wain in the Great Bear, and the remarkable results are shown in the above illustrations.

For Greek and Latin views as to the constellation see the articles ARCTOS and CALLISTO.

The Little Bear (*Ursa Minor*), which is back to back with the Great Bear (just above the equinoctial colure and with its tail extending to the pole, in the Plate CONSTELLATIONS, Northern Hemisphere), was made up to balance the Great Bear. It is one of Ptolemy's constellations, and is chiefly remarkable as containing at the tip of the tail the Pole-star, Stella Polaris, or Cynosure (Gr. *kunosoura*, dog's tail-tip), the star which in these days describes so very small a circle round the true pole of the heavens as to be able to stand with fair accuracy in a popular way for the pole itself. The Pole-star is a double star of the second magnitude. The stars α and β of the Great Bear are called the Pointers, because if an imaginary line be drawn through them and produced four times their length apart it will almost touch the Pole-star, passing a little to its left. Two stars in the fore-quarters of the Little Bear (β and γ *Ursæ Minoris*) are called the Guardians, as they appear to circle round the pole with never-ceasing watchfulness once in every twenty-four hours. They are readily found by regarding ζ ε δ β of the Great Bear as the base of a square, when the Guardians will be found in the upper left corner, diagonally opposite to β.

GREAT BRITAIN. This name was familiarly applied to the island which is composed of England, Wales, and Scotland long before the union of the crowns by James I.; but its legal application commenced at the time of the legislative union in 1706. Great Britain is the largest island in Europe, and the most important in the world. It is separated from the Continent by the English Channel and the North or German Sea; St. George's Channel separates it from Ireland; and the Atlantic forms the rest of its boundary. The Lizard Point, the most southern part of Great Britain, is in 49° 58′ N. lat., and Dunnet Head, in Caithness, the most northern point, is in 58° 42′ N. lat. The most eastern point is Lowestoft, on the coast of Suffolk, 1° 46′ E. lon., and the most western, Ardnamurchan Point, in Argyle, 6° 20′ W. lon. The distance in a straight line between the Lizard Point and Dunnet Head is about 608 miles; and from the Land's End to the North Foreland about 320 miles. The coastline is so deeply indented as to have an extent of nearly 4000 miles. The area is 89,643 square miles.

The respective proportions have been ingeniously illustrated by the registrar-general. Adopting the figure of a perfect square, the area of England is equal to one of 226 miles to the side; Wales, to one of 86 miles; Scotland, to one of 177 miles; and the whole of Great Britain, to a square of 299 miles to the side. Or adopting the figure of a circle, the area of England is equal to one with a radius of 127 miles; Wales, to one of 49 miles; Scotland, to one of 100 miles; and the whole of Great Britain, to a circle with a radius of 169 miles. The surface varies in its level from below high-water mark, in the fens of Lincolnshire, to the height of 4406 feet above the sea, in Ben Nevis, Inverness-shire.

The minor islands associated with Great Britain sometimes occur singly, but are more generally arranged in groups, and are situated chiefly along the northern and western shores. The Orkneys and Shetlands are on the north; the Inner and Outer Hebrides, Bute and Arran, the Isle of Man, Anglesea, and the Scilly Isles, on the west; the Isle of Wight on the south. The east coast has very few and only insignificant insular tracts. Some of the islands on the coast of Scotland are of great extent, and supply pasturage to flocks of from 300 to 400 sheep, though without regular human tenants, while others are so small as to admit of only one sheep being left at once, which is removed when fattened, and its place supplied by another. The most isolated inhabited spot is the precipitous St. Kilda, the outermost of the Outer Hebrides, with a village of bird-catchers and fishermen, 45 miles from the nearest neighbour.

The North Sea is comparatively shallow, except towards the Norwegian shores, for its mean depth for the whole

basin does not exceed 31 fathoms. The depth in the centre is generally less than on the eastern and western sides, except close to the coasts, owing to the accumulations of debris which encumber that part of its bed. One of these, the Dogger Bank, formerly a well-known station for cod-fishing, but now greatly exhausted, extends upwards of 300 miles from off Flamborough Head towards the coast of Denmark, where it terminates almost in a point, though in various places not less than 60 miles broad. Another enormous bank, known to mariners as the Long Forties, trends more than 100 miles in a north-easterly direction from the Frith of Forth. It has been calculated that the solid contents of these shoals, with the minor ones, if evenly distributed over the surface of Great Britain, supposing it to be a level plain, would cover it with a stratum of soil 28 feet in thickness. The shallowest part of the English Channel, about 25 fathoms, is at the narrow eastern extremity, between Romney Marsh and the opposite coast of France. From thence westward the soundings increase to 63 fathoms at the oceanic entrance. In general, there is greater depth of water on the English than on the French shores, and the ports and harbours are better.

The tides are very conspicuous on most of the shores, affect many of the rivers in a marked manner to a considerable distance inland, and give rise to some striking phenomena. On reaching our narrow seas, the ridge of the great oceanic tide-wave extends diagonally from the south-west coast of Ireland to the north-west projection of France, and sends off two branches owing to the interruption offered by the masses of land. An eastern branch enters the English Channel, and carries high-water to the opposite shores; a central branch runs up the Bristol Channel, and passes through St. George's into the Irish Sea; while the main or oceanic wave continues its course with immense velocity along the western coasts of Ireland and Scotland. This last, after rounding the Orkneys and Shetlands, becomes a great wave from the north, traverses the whole extent of the North Sea, and determines high-water along the coast to the mouth of the Thames. The tidal rise varies in its height at different points owing to the varying configuration of the shores, the form of the bottom, and the direction of incidence of the wave, attaining its maximum where bays and estuaries have their openings turned towards its advance and rapidly contract in their breadth. This condition is best fulfilled by the Bristol Channel, and accordingly there the ordinary rise of the tide is the greatest. It amounts to 30 feet in Swansea Bay, 38 feet at Cardiff, 40 feet at the mouth of the Bristol Avon, and occasionally to 60 feet at Chepstow on the Wye. In other places under similar circumstances, though not so marked, the tides rise as high as 22 feet at the entrance of Milford Haven, 26 feet at the mouth of the Mersey, 21 feet at the entrance of the Solway Frith, and 23 feet at the mouth of the Wash. Spring-tides, with coincident westerly gales, produce an immense accumulation of water in the upper part of the Bristol Channel, the estuary of the Severn. The flood remains pent up for a time by the narrowness of the river channel, till, having acquired sufficient power for disengagement, it violently breaks bounds, and rushes up the stream as a wall of water, with a crest of foam. Boatmen are warned of its approach, and thus enabled to secure their craft, by hearing the distant roar. Precisely similar to this "bore" of the Severn, and produced in the same manner, is the "heygre" of the Trent.

Bold projecting cliffs, and narrow channels between islets or shoals and the main shores, by obstructing the tide-wave, originate impetuous currents on many points of the coasts, justly dreaded in the days of timid and unskilful seamanship. Around the peninsula of Portland in Dorsetshire, and between it and a shoal on the south bearing the ominous name of the Shambles, with Deadman's Boy in the neighbourhood, the tide rushes with extreme violence, raising furious eddies and a dangerous surf. This has obtained the name of the Race of Portland; and has the turbulence of its waters typified on old charts by a fierce-looking monster or sea-dragon lashing them into foam. The Roost of Sumburgh designates the strong and tumultuous tidal flow between the Orkneys and the Shetlands, so called from Sumburgh Head, at the southern extremity of the latter group, and the Scandinavian *roost*, the term applied to agitated and powerful sea-streams. In the contracted Pentland Frith, between the Orkneys and the mainland of Caithness, the force of the tides and currents have, in many places, undermined the rocks, producing most fantastic shapes in the old red conglomerate—the prevailing formation of Pentland Frith. In those narrow seas the navigation is dangerous throughout to small craft, from the force of the tide and the strong eddies formed by currents on either side which run counter to the main stream. Vessels seldom venture to bring up, or if an anchor is let go, it is generally left at the bottom. The little isle of Stroma, on the southern side of the channel, has its Scylla and Charybdis: the one a whirlpool called the Swalchie; the other, an expanse of broken water, boiling like a witch's caldron, termed the "Merry Men of Mey," the word *men* being here a corruption of *main*. Between the islands of Jura and Scarba, two of the Southern Hebrides, the remarkable intermittent whirlpool of Coryvreckan is formed by the collision of opposite tidal currents. It attains its maximum of disturbance at the fourth hour of the flood—boils, foams, and rolls away in successive whirls, throwing up everything from the bottom h strong ebullition. The name is said to be derived from a Danish prince who perished at the spot.

> "Where the wave is tinged with red,
> And the russet sea-leaves grow,
> Mariners, with prudent dread,
> Shun the shelving rocks below!
>
> As you pass through Jura's sound,
> Bend your course by Scarba's shore;
> Shun, oh shun, the gulf profound,
> Where Coryvreckan's surges roar!"

On the low coasts the tidal oscillations diurnally abridge and extend the area of the shore by submerging and leaving dry extensive tracts. This is specially observed around the Wash, where thousands of acres have been permanently reclaimed from the sea, in the Solway, and in Morecambe Bay. The latter estuary interposes between the towns of Lancaster and Ulverstone. They are about 20 miles apart in a direct line, but twice that distance passing around the head of the bay. By the ebbing of the tide the intervening space is left perfectly dry, except in the narrow channels of two small streams, the Kent and the Leven; and it is then traversed by travellers on horseback and by vehicles. But the route of the "Sands" has occasionally its perils, when dense fogs arise, or driving snowstorms come on, or when a strong westerly wind springs up, which accelerates the return of the waters, and gives great violence to their flow.

Both formidable and interesting animals, the bear, beaver, wolf, and wild boar have become extinct within the limits of the kingdom since the dawn of authentic history. The bear was common in the Roman times, and conveyed to Rome for the sports of the amphitheatre. It existed in Scotland in the eleventh century, for in the year 1057 one of the Gordons was allowed to carry three bears' heads on his banner in honour of his valour in killing one. Several places in Wales retain the name of Pennarth, or the bear's head, indicating its presence in the Principality. The wolf so infested the homesteads of the Anglo-Saxons in winter, that the month of January was called *Wolfmonat*. It was extirpated in England by systematic measures taken for

its destruction by Edward I.; but remained in Scotland four centuries later, the last having been killed by Cameron of Lochiel in 1680. A few examples of the wild boar, once stringently protected for purposes of the chase, were in the New Forest down to the reign of Charles I. Wilberfel, or Wild-boar Fell, denominates a district in Westmorland. The urus or wild ox, a gigantic creature, roamed in the forests near London in the time of the first Plantagenet, and is mentioned at a much later date in other parts of the country. The beaver, the broad-tailed animal of the Welsh, was in the Principality at the commencement of the thirteenth century, inhabiting the Teify. A few pools there bearing the name of *Llyn yr afange*, "the beaver lake," preserve its memory, as does the name of Beverley in Yorkshire, "the place of beavers." Some birds have likewise disappeared, as the capercailzie, a member of the grouse tribe, not uncommon in Scotland at the beginning of the last century, and recently reintroduced from Norway; the great bustard, last seen in the eastern counties of England in the early part of the present century; and the stork, once a regular summer visitor from a warmer climate to the fenny districts, and still a migrant to Holland.

From the principal highlands running north and south, while occupying a westerly position, it follows that the general slope of the country is from west to east, and thus nearly all the important rivers flow into the North Sea, with the exception of the Clyde, the Mersey, and the Severn. Every river of importanc is described either a separate article or in the county with which it is more immediately connected, but we here give a list in the order of the magnitude of their basins:—

Rivers.	Area of Basin. Sq. Miles.	Length. Miles.
Humber, . .	9550	171
Severn, . . .	8580	239
Thames, . .	6160	220
Great Ouse, .	2960	150
Tay, ...	2750	130
Tweed, . . .	1870	96
Mersey, . . .	1748	70
Clyde, . . .	1580	98
Avon (Wilts), .	1210	70
Spey, . . .	1190	110
Yare, . . .	1180	60
Nen, . . .	1132	100
Tyne, . . .	1100	80
Witham, . .	1050	70
Eden, . . .	991	72
Dee, ...	862	80
Tees, . . .	744	80
Ribble, . . .	720	60
Welland, . .	708	60
Dee (Scotland),	705	90
Parret, . . .	653	45
Forth, . . .	645	60
Exe, . . .	643	55
Tamar, . . .	603	55
Don, . . .	530	62
Towy, . . .	506	70

The climate of the kingdom is remarkably mild, considering its position in the northern half of the temperate zone. Those great extremes of winter cold and summer heat which are experienced in corresponding continental latitudes, both eastward in Northern Germany and Central Russia and westward in transatlantic regions, are unknown; while the average of temperature throughout the year is much higher. This absence of violent seasonal alternations is favourable alike to comfort and health. It -western of England, where the winters are so mild that in sheltered bays myrtles, citrons, camellias, hydrangeas, magnolias, cactuses, and other exotics, bear unharmed the open air without any protection but what is afforded by the neighbouring hills. The coldest district is an easterly section, extending from the Naze, in Essex, to the Frith of Forth, and stretching some distance inland. The warmest embraces the Isle of Wight, with parts of the counties of Hants, Dorset, Devon, Cornwall, Somerset, Gloucester, and Glamorgan. The hottest month in general is July, and the coldest January. Mists and frequent weather changes, with cold easterly winds in spring, are the principal defects of the British climate; but the measure of health enjoyed by the people, with the average duration of life, is not surpassed, if equalled, in any other country.

The vegetation of the British Isles varies with the several localities; in many respects the mountain vegetation differs widely from the vegetation of the plains and valleys. The flowers which deck the woods and fields have no representatives in mountain regions. Where a few hardy kinds do succeed in climbing to the summits of the Highland hills, a recent writer says, "they assume strange forms which puzzle the eye, and become dwarfed and stunted by the severer climate and ungenial soil. All alpine plants found in the Highlands," the same writer adds, "are universally admitted to be of Arctic or Scandinavian origin. Their primitive centres of distribution lie within the Arctic circle, where they are found in profusion, constituting the sole flora of very extensive regions. From these northern centres they were gradually distributed southwards over the British hills during the glacial epoch, when the summits of these hills were low islands, or chains of islands, extending to the area of Norway through a glacial sea. This floral migration may be traced from the Arctic regions to the higher ranges of the Alps."

The mass of the vegetation is identical with that of the neighbouring continent. But a wanderer from afar appears in the Hebrides, which has established itself from transatlantic regions, owing doubtless to seeds still retaining the power of germination having been drifted thither by the Gulf Stream. This is the jointed pipewort, a grass-like plant, growing in lakes which have a muddy bottom, and exhibiting small globular heads of flowers. But it bears little resemblance to its congeners in their more congenial natural habitation, which are shrubby, from 4 to 6 feet high, with leafy branches on their stems, and are prominent features of the vegetation in parts of South America. Another migrant, the three-toothed cinquefoil, abundant in the Rocky Mountains and Arctic America, occurs on a Forfarshire hill in Scotland, to which it is limited. A third intruder, of recent date, the water weed (*Anacharsis alsinastrum*), first observed in the year 1842, and now well known in the rivers, canals, and drains of the midland counties of England, is supposed to have sprung from seeds brought with timber from Canada during the construction of the railways.

The native flora may be divided into four groups—Germanic, Scandinavian, Asturian, and Armorican, so called from the continental localities where the same species are now found, and whence, in the opinion of Professor Forbes and other geologists, they originally came to our shores. 1. The Germanic group comprises the principal components of vegetation, such as *Sibaldia procumbens*, *Arenaria rubella*, *Gentiana nivalis*, and all the widely diffused species—trees, shrubs, weeds, and wild flowers—which belong equally to the middle latitudes of Europe. 2. The Scandinavian group is chiefly represented in the Highlands of Scotland, and to a smaller extent on the loftier mountains and bleak moorlands of England and Wales. It consists of mosses, lichens, and

grasses, some highly beautiful flowering plants, and prized berry-bearing shrubs, as the cranberry, bilberry, and cloudberry, which are abundant in Scandinavia, on alpine heights in general, and also in the Arctic lowlands. Among the selected for illustration are, *Verbascum lychnides*, *Linum perenne* (common flax), *Rubus chamæmorus* (the cloudberry), *Gentiana pneumonanthe*, *Thlaspi perfoliatum* (shepherd's purse), *Dipsacus pilosus* (common teazel), and *Caucalis daucoides* (the small burred parsley). 3 and 4. The Asturian and Armorican groups are extremely local. Some heaths occur, as *Erica Mediterranea* (London pride), *Arabis ciliata* (the wall-cress), *Arbutus unedo* (the strawberry-tree), and some others. On the south-west coast of England, a vegetation appears which is closely allied to that of the opposite shores of Brittany and Normandy, the ancient Armorica, but which is precluded from a more northerly advance by the less genial character of the climate. Such are *Rubia peregrina* (wild madder), *Erica vagans* (the Cornish heath), and *Scrophularia schradonia* (fig worts).

The native woods include the oak, elm, birch, beech, ash, alder, aspen, willow, poplar, maple, pine, yew, holly, hazel, blackthorn, and hawthorn; while the lime, chestnut, walnut, spruce-fir, larch, weeping willow, Lombardy poplar, laburnum, mulberry, and cedar have been introduced by man from foreign countries. The co elm, maple, and beech are peculiarly English, occurring chiefly in southerly localities, diminishing northwards, or not ranging to Scotland. This is the case also with several striking ornamental plants, as the mistletoe, sweet violet, daffodil, mezereon, star of Bethlehem, and the familiar creep *Clematis vitalba* (or traveller's joy).

> "Name well bestowed
> On that wild plant which, by the road
> Of southern England, to adorn
> Fails not the hedge of prickly thorn"

The birch, alder, mountain ash, wych-elm, poplar, and pine, or Scotch fir, are eminently characteristic of Scotland. There the latter is frequently a very noble object, altogether different to what it appears on the stiff clays of England, for the natural character of the pine is best developed in bleak situations, amid mountains, crags, and waterfalls, where

> "Moor'd in the rifted rock,
> Proof to the tempest's shock,
> Firmer he roots him the ruder it blows"

Vast tracts of woodland have disappeared from the surface, owing to the increase of population, the extension of culture, and the demand for timber, with the abatement of the passion for the chase. Seventy-seven forests were once enumerated in England alone as the property of the crown. They were successively disafforested till the number was reduced to eleven; but only six of these have now any important extent—the New Forest, in the south-west, and Woolmer Forest, in the south-east of Hampshire; Dean Forest, between the Severn and the Wye; Whittlebury Forest, in the south-east of Northamptonshire; Windsor Forest, Berks; and Delamere Forest, Cheshire. Yet out of a total area somewhat exceeding 100,000 acres, little more than one-third is actually woodland. Many parts of the country still retain the denomination of forest which have entirely lost that distinctive character, as Macclesfield Forest, Cheshire; Needwood Forest, Staffordshire; Charnwood Forest, Leicestershire; and the Forest of Arden, Warwickshire.

Among the wild native animals, the large examples are ruminants. They consist of the fallow-deer, semidomesticated in parks; the red deer, roaming the solitudes of the North of Scotland in herds, and found also in a few retired localities in England; the roebuck, limited to the Scottish Highlands; the goat, semi-wild in Wales; and the wild cattle preserved in Chillingham Park, Northumberland, perhaps the descendants of a domesticated breed which broke from the homesteads in turbulent times, and returned to natural habits in the woods. The carnivorous race is represented by the fox, five of the weasel family, and the otter, formerly much more common than at present; the wild cat and badger, both very scarce; the hedgehog, found in almost every part of our islands, but not numerous; the mole, very common in England, but not known north of the Pentland Frith; and nine species of bat. Of the rodents, varieties of the hare and rabbit are generally diffused, as is the squirrel, in England and Scotland; but it has only recently been known in Ireland, by introductio to the county of Wicklow. The reptiles include the blind worm, ringed-snake, and adder or common viper, the last of which alone is venomous. Upwards of 10,000 British insects are known to naturalists and described by them.

The feathered tribes number a very large proportion of species, considerably more than one-half of the total belonging to Europe; and individuals are equally numerous with species, notwithstanding much thoughtless destruction. An insular position invites the families of waders and swimmers to the shores, while the great extent of cultivated country, and the abundant vegetation, provide a supply of food for the smaller birds. Some are summer visitors from the southerly latitudes, which range over the entire kingdom, as the cuckoo and swallow; while the two splendid warblers, the nightingale and blackcap, are comparatively local. The nightingale does not visit Scotland or Wales, nor is it known in Cornwall, the west of Devon, or much further north in England than about the neighbourhood of York. Examples noticed beyond these limits are accidental stragglers. The fig-eater, common in Italy and the South of France, is an annual migrant to the fig-orchards in the neighbourhood of Worthing, Sussex, about the time of the ripening of the fruit. Of the game-birds, the black grouse is found on moors in England and Scotla he red grouse occurs generally, and is peculiar to the British islands; the white grouse, or ptarmigan, is only met with on the wildest and highest of the Scotch mountains. Most of the common domestic fowls, with the peacock, turkey, and pheasant, are of foreign origin. The seas, rivers, and lakes yield a supply of those varieties of fish in great quantities which are most serviceable for human sustenance—the salmon, cod, herring, mackerel, and pilchard. The last three periodically leave the deep water as the spawning-season approaches, and draw near to the shores in vast swarms, when the respective fisheries are prosecuted with great activity. The herring is the most diffused, though far more abundant on some parts of the coast than others; the mackerel is chiefly taken on the southern and south eastern shores of England; the pilchard shoals confine themselves to its south-western corner, the counties of Cornwall and Devon.

In no part of the world is there known to be an amount of mineral wealth within the same area equal to that of the United Kingdom. Gold occurs; and the Romans conducted regular mining operations for it in Carmarthen- Wales. Stream-gold was found on the southern borders of Lanarkshire, Scotland, about the commencement of the sixteenth century, but the search eventually proved unremunerative. Silver is also met with in a native or pure state, and it accompanies galena, a sulphuret of lead, frequently in sufficient quantity to render the extraction profitable. But the mineral stores of inestimable importance are those which are the prime producers of wealth and comfort in the hands of an instructed and industrious people; and these are possessed in vast abundance and convenient juxtaposition. They include iron, copper, lead, tin, zinc, coal, and salt, with other varieties of less consequence, as antimony, manganese, graphite, alum, and fuller's earth, besides ample supplies of building stone, roofing-slate, marbles, and the clays which are

suitable for the commonest ware and the finest porcelain. Tin and lead works are of the oldest date. The tin of Devon and Cornwall was wrought by the ancient Britons, whose mining labours in the latter county, at the extreme angle, are commemorated by the singular excavations, called the Pit, the Land's End Hole, and the Devil's Frying-pan. Lead was certainly wrought by the Romans, as blocks of the metal bearing Latin inscriptions have been found on the moors of Derbyshire. Mineral waters, or springs impregnated with saline, chalybeate, and sulphurous compounds, variously cold, tepid, and warm, are numerous. But no warm springs occur in Scotland, nor are they known in England further north than the Derbyshire Peak.

The area of Great Britain is estimated at 89,643 square miles, or 56,964,260 acres, viz.:—

	Square Miles.	Acres.
England, .	. 50,922 ..	32,597,398
Wales, .	. 7,397 ..	4,721,823
Scotland,.	. 31,324 ..	19,496,132
Total,	89,643	56,815,353

England is divided into forty, and Wales into twelve counties; these counties have from early historical times been subdivided again into hundreds, tithings, townships, parishes, and other subordinate territorial units. This has not been done on any settled uniform plan. The English county boundary even now divides many parishes, each divided parish being therefore in two counties; and detached parts of parishes are dispersed in the midst of other parishes. The division of the country into unions was made, again, with no regard to the hundred, and little regard to the county boundaries; the borough boundaries were also set at nought—convenience, in fact, in administering the new poor law was alone considered by the commissioners.

The number of inhabitants and houses in England and Wales have trebled since the commencement of the century, thus:—

Years.	Population.	Houses Inhabited.
1801, .	8,892,536 ...	1,575,923
1811, .	10,164,256 ...	1,797,504
1821, .	12,000,236 ...	2,088,156
1831, .	13,896,797 ...	2,481,544
1841, .	15,914,148 ...	2,943,945
1851, .	17,927,609 ...	3,278,039
1861, .	20,066,224 ...	3,739,505
1871, .	22,712,266 ...	4,259,117
1881, .	25,974,439 ...	4,831,519

The population increased rapidly from 1801 to 1811, while the French War was going on, and most rapidly after the peace; the increase from 1811 to 1821 was 18 per cent., and from 1821 to 1861, while emigration grew every year more extensive, the population went on increasing, but at a decreasing rate, so that in the decennial endi[ng] in 1861 the increase became 12 per cent.; the actual addition to the numbers was every ten years (except in 1841-51) greater than in the ten years preceding, but it was never so great before as in the ten years ending 1881, when the addition was 3,262,173.

The population of England and Wales at home in 1801, when the first census was taken, was 8,892,536; and the mere increase of Englishmen from 1841 to 1881 was than 10,000,000, or 1,000,000 more than the whole of those existing in the year 1801, when the country was engaged in the great conflict with France and with the armed sovereigns of the north of Europe.

England and Wales are more densely peopled than any other country in Europe except Belgium, there being 445 persons to every square mile.

The population of Scotland at the various census periods has been as follows:—

1801, . .	1,608,420	1851, . .	2,888,742
1811, . .	1,805,864	1861, . .	3,062,294
1821, . .	2,091,521	1871, . .	3,360,018
1831, . .	2,364,386	1881, . .	3,735,573
1841, . .	2,620,184		

The total population of Great Britain (including the Isle of Man and the Channel Islands) was 30,066,646 in 1881. The increase in Scotland has not been quite so large in proportion as in England and Wales. Further particulars of the population of the United Kingdom will be found in the articles CENSUS and IRELAND. The area, population, &c., of the colonial possessions of Great Britain are given under COLONY; and the emigration from the United Kingdom is illustrated under EMIGRATION.

History.—The earliest record of the British Isles at a known date occurs in the writings of Aristotle, who, writing about 340 B.C., refers to them under the names of Albion and Ierne, which are described as the principal members of a group. The former name is supposed to signify the *fair* or white land, in allusion to the appearance of the chalk-cliffs prominent on the southern coast of England; and the latter, applied to Ireland, is commonly regarded as a relative designation, meaning the western island. Rather more than half a century before the Christian era Julius Cæsar landed on the shores intent on conquest, but made no stay, and accomplished no important result, with the exception of becoming acquainted to some extent with the inhabitants, character, and resources of the region, and imparting his knowledge to the civilized world. About a century later his enterprise was followed up by other leaders, and the larger part of Britain was gradually reduced to the condition of a Roman province. [See BRITAIN.] Four centuries later, the declining power of the empire enforced the retirement of the legions, and the aborigines were left independent. They consisted of numerous Celtic tribes belonging to two main branches of the family, the Gaelic and the Cymric, who migrated from the Continent prior to the dawn of history, and spoke widely distinct languages, though offshoots of a common stock. The Gaels seem to have come first, and to have been driven northward to the Scottish Highlands, and westward into Ireland by the intruding Cymry. With these last-named natives the Romans came chiefly in contact. After the departure of their masters, having largely lost the spirit of freedom by long subjection to them, they fell a prey to Teutonic invaders of the Germanic race, and numbers were reduced to servitude, finally coalescing with them; while others withdrew to the mountain-fastnesses of Devon, Cornwall, Cumberland, and Wales, to preserve their liberty, and remained a distinct body. This expatriated class received the name of *Wilisc-men*, strangers or foreigners, expressive of their relation to the new-comers, while their territory was called *Wilisc-land*, terms from which Welshman and Wales have been formed. But the Welsh proper have continued to the present day to distinguish themselves by the name of Cymry.

The conquering immigrants are historically known as Jutes, Angles, and Saxons. They came from the river-basins of the Eyder, Elbe, Weser, Ems, and Rhine. With the second of these tribes the denomination of England arose, which is only an abbreviation of *Angle-land*. After several separate states had co-existed, the larger and more powerful absorbed the small and weak, till all were included in a single Anglo-Saxon monarchy, about the year 823, which had an uninterrupted succession of sovereigns for a period extending to nearly two centuries. But during almost the whole of this term, the Danes and other Scandinavians, a different branch of the Teutonic family, infested the coasts. They seized the

Orkneys, Shetlands, and Hebrides; occupied a considerable portion of the north of Scotland; acquired possession of the eastern and midland districts of England, which had the name of the *Danelagh*, or Dane-law, from being formally ceded to them; and finally founded a short-lived Danish dynasty for the whole kingdom. Soon after its close the Normans effected its conquest in 1066. A considerable number of that race continued to come over for a century and a half afterwards, or while Normandy and England were politically united; and during the period a broad distinction subsisted between the Norman and the English part of the population. It was gradually effaced upon the separation of the two countries by association and alliances, till victors and vanquished were fused into one homogeneous people. Some leading epochs in the subsequent history of the British Isles are the establishment of the English power in Ireland during the reign of Henry II.; the conquest of Wales by Edward I.; the union of the kingdoms of England and Scotland under one crown in the person of James I.; their legislative union in one kingdom in 1707; and the similar incorporation of Ireland in 1799.

Existing nomenclature commemorates the Celt, the Roman, the Anglo-Saxon (*Englisc*), and the Dane. Commonly the enduring objects of nature, as rivers, lakes, mountains, and valleys, have names of Celtic origin. Thus *afon* or *avan*, a running stream, appears as the denominative of numerous rivers, the Avons, five of which are in England, two in Wales, and three in Scotland, the latter sometimes called Aven. The Ouses and Esks, the Axe, Exe, Usk, and Wiske, are related to *uisge*, water, or to *isca*, the Latinized form of the word. As a prefix, *beinn*, *ben*, or *pen*, a mountain, hill, or promontory, is widely diffused. The examples are Ben Lomond and numerous others in the Scotch Highlands; Penygent in Yorkshire; Pendlehill in Lancashire; and Pen-maen-mawr, the mountain of the great stones, one of the Snowdon heights in Wales. The term *glen* or *glyn*, a narrow valley, with various affixes, is equally general, and the instances repeatedly occur: Glencoe in Scotland, Glendalough in Ireland, Glendon in England, and Glyntaf in Wales. Among ancient monuments the grassy mounds or barrows common on downy heath-clad plains, in which no coins are found, but only human bones, with articles of the rudest description, may be regarded as belonging to the purely Celtic age.

Many names of inhabited sites are derived wholly or in part from the Latin, and bear witness to the presence of the Romans. Thus *coln*, the abbreviated form of *colonia*, a colony, appears in Lincoln; and *wich*, a derivative from *vicus*, a village, in Norwich, Greenwich. The word *strata*, a street or paved way, is a component in the many Stratfords, and occurs with slight alteration in Streatham, Stretton, and the names of many villages, even some solitary houses, on the line of the great Roman roads. From *castra*, a camp, we have *chester*, *cester*, *caster*, and *caistor*, occurring alone, and in various combinations, forming both prefixes and terminals, as Chester, Chesterfield, Manchester, Cirencester, Tadcaster, and Caistor St. Edmunds. The association of the word with the name of some adjoining river is frequent, as Lancaster, the camp on the Lune; Doncaster, the camp on the Don; Colchester, the camp on the Colne. Material memorials of the Roman age embrace coins and medals of the empire, inscribed blocks of tin and lead, tesselated pavements, and bronze statues; remains of highways, baths, villas, temples, amphitheatres, fortresses, and the great northern wall; with altars, urns, vases, weapons, domestic implements, and tombs.

Traces of the Danes and Northmen remain in the districts principally visited or occupied by them, where a nomenclature of Scandinavian origin is prevalent. Among the maritime examples are *frith* or *firth*, an estuary—Dornoch Frith, Solway Frith; and *ness*, a promontory—Tarbet Ness, Winterton Ness, of which the Naze, in Essex, is only an altered form. Inland sites have *dale*, a valley, frequent in the south of Scotland and north of England, ranging towards the midland counties—Tweeddale, Teesdale, Dovedale, and Dale Abbey; *fell*, a mountain—Sea Fell, Cross Fell, Fountain's Fell; and *force*, a waterfall—Mickle Force on the Tees, Scale Force on a small Cumbrian stream. In the names of inhabited places the occurrence of *toft*, a field, as Lowestoft, points to a Danish origin; but the instances of its use are limited, amounting to only twenty-two times in England, while absent entirely from Wales. A far more general terminal is *by* or *bigh*, signifying originally a single farm or dwelling, and then extended to a town, as Whitby, Derby, Denbigh. It occurs 195 times in Lincolnshire, 160 in Yorkshire, 63 in Leicestershire, and 42 in Cumberland, or altogether 570 times in England and 8 in Wales, but not once in the counties of Middlesex, Berks, Oxford, Buckingham, Herts, Hants, Surrey, Sussex, Wilts, Dorset, Devon, Hereford, Worcester, Salop, Bedford, Huntingdon, and Cambrid

In the designation of inhabited places names of Anglo-Saxon birth vastly predominate, and are most widely diffused, but are rare in Cornwall, Wales, the west and extreme north of Scotland. They include *hurst*, a wood—Chiselhurst, Penshurst; *ford*, the point of passage over a stream—Oxford, Brentford; *stead*, a station—Grimstead, Wanstead; *lea* or *ley*, a plain—Finchley, Bromley; *worth*, a manor—Isleworth, Handsworth; *burh*, *burgh*, or *borough*, a regularly constituted or fortified town—Edinburgh, Gainsborough. Far more common is *ham*, a home—Waltham, Farnham. It thus occurs as a terminal 678 times in England, chiefly in the eastern and south-eastern counties, and only 3 times in Wales, besides being met with as a prefix, as in Hampstead, Hampshire. But *ton*, originally used to denote any inclosed space or single farmhouse, and thence extended to a collection of dwellings, village, or town, has an immense numerical majority of examples. The instances of its occurrence as a terminal, as in Stockton, Burton, Clifton, number 2798 in England and 78 in Wales. It is most frequent in Yorkshire, and then successively in Cheshire, Somersetshire, Lancashire, the counties of Lincoln, Gloucester, and Wilts. In addition, the word *ham* forms a compound with *ing*, son of or descendant, as in Rockingham, "the home of the family of the Rock," instances of which are not included in the above enumeration. Nor are those reckoned in which *ton* enters into the same combination, as in Bridlington, Islington. The information upon which th preceding statements are founded is derived from an unattractive but instructive table appended to the census returns, entitled "Common Terminations of the Names of Places in England and Wales."

The area in which Celtic blood at present prevails to a greater or less extent, though only comparatively pure in general, embraces Wales, Cornwall, the Isle of Man, the Highlands of Scotland, its Western Isles, and great part of Ireland, especially the west and south. In this region the extant dialects of the Celtic stock are the Welsh, the Manx, the Gaelic, the Erse or Irish, but all declining rapidly as vernacular modes of speech; while a comparatively slender form, a volatile temperament, a quick perception, with a want of caution, providence, and perseverance, distinguish the purest representatives of the race. Another dialect, the Cornish, closely allied to the Welsh, formerly spoken in Cornwall and the adjoining part of Devon, stood its ground till the period of the Reformation, when the service of the church in English being introduced, the old language began gradually to give way before it. Carew, writing at the commencement of the seventeenth century, states that though English was then generally understood, some of the people would affect ignorance of it, and reply to the question of a stranger, ***Mee a navidra***

couza Sawzneck, I can speak no Saxonage. In villages towards the south-western extremity of the county the Cornish was spoken in the reign of Queen Anne. It lingered longest in the neighbourhood of Mousehole, between Penzance and the Land's End, and was not finally blotted from the list of living languages till the middle of the last century. Specimens remain both in manuscript and print. The inhabitants of Cornwall now speak a remarkably pure English.

The region of Teutonic blood, more or less pure, derived from the immigrant Germanic and Scandinavian tribes, includes England generally, the Lowlands of Scotland, the maritime portion of its northern counties on the eastern side, the Orkneys and the Shetlands, with the north-east and east of Ireland. Great bodily strength distinguishes the people of the purest blood, with a disposition more inclined to the grave than the gay, a reserved manner to strangers, a slow but accurate perception, a preference of the useful to the brilliant, a strong desire for personal and political independence, a love of enterprise, and a common predilection for maritime occupations. The languages are the English, based upon the Anglo-Saxon; and the Lowland Scotch, a parallel and sister-dialect, derived from the same source, but marked with Norse or Scandinavian features, now rapidly giving way to pure modern English. Anglo Saxon is believed to have been formed out of the respective dialects of the Jutes, Angles, and Saxons, when they became consolidated as one people in a common monarchy. It was spoken in its purity from the age of Alfred to the Norman Conquest, was one of the earliest cultivated languages of modern Europe, and was made the vehicle of written laws, poetry, and history before a single line had been penned in Italian, French, or Spanish. After the Conquest it underwent a change to semi Saxon, influenced by that event, with various other causes; and subsequently passed through the successive stages of Early English and Middle English, into the beautiful and copious but composite mother-tongue of the great mass of the population, which has gathered its vocabulary from almost every nation under heaven, and is now spoken in different countries by more than 70,000,000 of the human race. "Not one hour of the twenty-four," remarks an exponent, "not one round of the minute-hand of the dial is allowed to pass, in which, on some portion of the surface of the globe, the air is not filled with accents that are ours. They are heard in the ordinary transactions of life; or in the administration of law—in the deliberations of the senate-house or council-chamber—in the offices of private devotion, or in the public observance of the rites and duties of a common faith."

History, Legislation, and Statistics.—In the different volumes of the *National Encyclopædia* there is a large body of information illustrative of the history, government, legislation, commerce, productive industry, and social relations of Great Britain. It will suffice to refer to those articles, without repeating the details here:—

The early history of the island is given more fully than in the above sketch in the article BRITAIN; the later history, under ENGLAND, SCOTLAND, WALES, and especially under the names of the kings.

The government and legislation are illustrated under CABINET; CHANCELLOR; NATIONAL DEBT; PARLIAMENT; PEERS; COUNCIL; PRIVY COUNCIL; STATUTES, &c.

Local government is treated under such heads as COUNTY RATE; LOCAL GOVERNMENT BOARD; MUNICIPAL BOROUGHS; PARISH; POLICE; PAUPERISM and POOR LAWS.

For judicial institutions and proceedings, see ASSIZE; BANKRUPT; CORONER; COURTS; JURY; JUSTICE; SESSIONS; SHERIFFS, &c.

Religion and education are illustrated under BENEFICE; BISHOPRIC; CLERGY; ESTABLISHED CHURCH; NONCONFORMISTS; SCHOOLS; UNIVERSITIES; &c.

For commerce and trade see BANK; CUSTOMS DUTIES; FRIENDLY SOCIETIES; IMPORTS AND EXPORTS; INLAND REVENUE; INSURANCE; JOINT-STOCK BANKS; RAILWAYS; SAVINGS BANKS; SHIPS, &c.

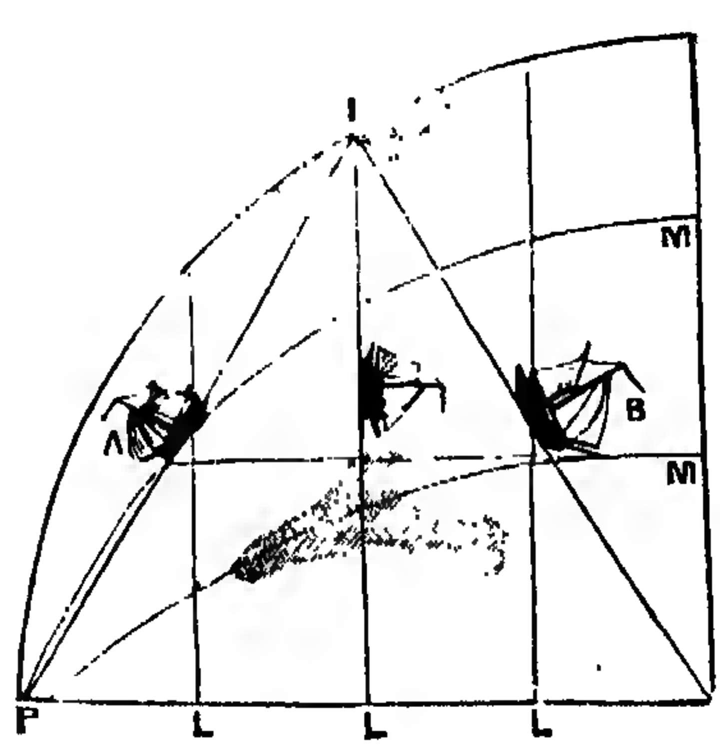
For produce, manufactures, and mines, see the names of the various articles.

In the articles ARMY (BRITISH) and NAVY will be found a history of the British army and navy from the earliest periods.

For literature see the articles on ENGLISH, SCOTCH, WELSH, and IRISH LITERATURE.

GREAT BRITAIN, ROYAL ARMS OF. The monarchs of England have from the earliest periods of heraldry adopted the lion as their device, but the coat-of-arms worn by royalty in this kingdom has undergone numerous changes at various times. Our earliest kings are said to have borne *leopards*, not *lions*, and this down to the fourteenth century. But the discrepancy disappears when we know that the older heralds refused to blazon a lion otherwise than rampant. Scott, in the famous scene in the "Talisman," with his usual accuracy in matters of the sort, makes the Duke of Austria refer to the change from leopards to lions as recent in Richard I.'s time. Edward III. quartered the arms of France with those of England. Mary united those of Spain after her marriage with Philip II.; James I. added the arms of Scotland and Ireland, the first and fourth quarters representing France and England as before, the second the lion rampant of Scotland, and the third quarter the harp of Ireland. In the reign of Anne, England and Scotland were impaled in the first and fourth quarters, France in the second, and Ireland in the third. George III. renounced the titular assumption of King of France, and the arms of England were represented in their present form, except that the arms of Hanover were added on an escutcheon of pretence.

GREAT CIRCLE SAILING. It is manifest, upon the consideration of the great circles of a sphere, that the shortest route from one place to another on the surface of the earth is along an arc of a great circle. Great circle sailing (or *tangent sailing*), therefore, is an art of much



value. To sail due west along a parallel of latitude, for instance, would be a great waste of time; for though on the map, or by the compass, the ship's head would be set directly toward her destination, yet in reality she would never once be heading direct for her port. In great circle sailing in the northern hemisphere the ship's course must be to the north of the compass direction, and in the southern hemisphere it must be to the south of the compass direction.

The preceding diagram represents a section of one-fourth part of the earth. M M are meridians, which meet at the pole, P; and L L are parallels of latitude. In the diagram two ships, A and B, are represented starting from the same point, I, say 20° N.; and suppose the ship A to sail to

60° N. and 10° W., and the ship B to sail to 10° N. and 10° W., it will be evident that the ship B sails a greater distance than the ship before they both come to the same meridian.

The degrees of longitude (measured along the parallels of latitude) become shorter and shorter as we approach the pole. A degree at the pole is a point, and thence it increases to over 69 miles at the equator. Manifestly, therefore, great circle sailing, by taking advantage of the shorter degrees nearer the pole, has less ground to traverse than ordinary sailing, which keeps along the apparently direct course of the parallel of latitude. On Mercator maps the great circle courses show in curves against the straight lines of the parallels. In gnomonic maps they are, however, represented by straight lines.

GREAT CIRCLE. A great circle of a sphere is one which passes through the poles of it, so that if the sphere were cut across by a plane passing through this circle it would be divided into two exact hemispheres; the plane would pass through the centre of the sphere. Therefore the meridians of longitude on the earth, the equator and the ecliptic, are great circles. Not so the parallels of latitude, not one of which, save only the equator itself, is a great circle. See GREAT CIRCLE SAILING.

GREAT COUNCIL. See COUNCIL, THE KING'S.

GREAT MARLOW, a market-town, and formerly a parliamentary borough, in the county of Bucks, pleasantly situated on the northern bank of the Thames, which is here crossed by a suspension bridge of 225 feet span. 30 miles from London by the Great Western Railway. The town consists of several streets converging in a large open market-place. It is rather irregularly built, but contains some good modern houses and a fine town-hall. The parish church is a modern and handsome building surmounted by a spire. There are places of worship for Roman Catholics and dissenters, a lecture hall, and literary and scientific institution. The town has a good trade in corn, coal, and timber, and small quantities of lace are still made; but the chief support is derived from its position in the midst of a rich and productive country, inhabited by wealthy landowners. The borough returned two members to the House of Commons from 1295 to 1867, when it was deprived of one. Its limits were extended by the Reform Act of 1832, and made to include Little Marlow, Medmenham, and Bisham (the latter in Berkshire), but the Redistribution Act of 1885 deprived it of its existence as a parliamentary borough. The population of Marlow alone is 4763.

GREAT OOLITE. See BATH OOLITE.

GREAT ORGAN, the main division of an organ. In an organ of two manuals (great and swell) the great manual is the lower one; in one of three manuals (swell, great, and choir) the great keys are in the middle. The weight of tone is always thrown upon the great organ. See ORGAN.

GREAT SALT LAKE, a remarkable lake of the United States, in the territory of Utah. It lies in a valley between the Sierra Nevada and the Rocky Mountains. It is 70 miles in length and 30 in breadth, and has an average depth of about 80 feet. Two islands, in the south part of the lake, Antelope and Stansbury, each about 15 miles long by 5 miles broad, rise in long ridges, parallel to the axis of the lake, to the height of nearly 3000 feet; while two others, much smaller and further north, reach 700 and 900 feet; and there are several still smaller. The depth over a great part of the lake is very inconsiderable, the shores being in many places inaccessible even in boats. The depth, size, and saltness vary, however, with the season. The winter is very severe, and the surrounding mountains are then covered with snow. On the return of spring it receives immense floods of fresh water, besides several persistent rivers, as the Jordan from Lake Utah on the south, the Weber on the east, and the Bear River on the north. The latter, where it breaks through the Wahsatch Mountains, at "The Gates," 25 miles north-east of the lake, is 200 feet wide and 12 feet deep. But there seems to be a constant supply of saline matter from springs, many of which occur in various places round the lake. There are also hot springs of various mineral contents, some sulphur, others salt, and others impregnated with iron. The specific gravity of the water is 1·17; it contains 20 per cent. of common salt or pure chloride of sodium, and not more than 2 per cent. of other salts—thus forming "one of the purest and most concentrated brines known in the world." The water of the lake is destitute of every form of animal life; but its islands and shores are frequented by multitudes of pelicans, gulls, snipes, and some other birds. Extensive beds of the exuviæ of insects occur on some parts of the lake, particularly toward the north-east. In the entire circuit of the lake scarcely a tree is met with till the cañons or river gorges among the hills are reached. Stansbury Island is an exception; on it cedar trees were found as far up as the summit, 3000 feet. The rocks belong to the Primary, Silurian, and Carboniferous series, there being no rocks newer than limestone of the latter age. The elevated ranges on the west, south, and north of the lake are capped by this limestone, overlying conglomerate, and probably also the eastern ranges; while granite, quartz rock, sienite, mica and talc slates, and some Cambrian or Silurian slates and trap rocks occur at lower levels. The climate of the whole basin is highly salubrious. A smaller fresh-water expanse on the south, Lake Utah, pours its overflow into it by the river Jordan, and it also receives the waters of the Wear from the north. The inhabitants of the region around were till lately nearly all Mormons, or, as they denominate themselves, "The Church of Jesus Christ of the Latter Day Saints." Originally they emigrated from the state of Illinois, in order to secure freedom from molestation in the great mountain valley, and have been annually joined by converts from the old countries of Europe. Notwithstanding the wild fanaticism of their religion, which inculcates polygamy, they have been very energetic and successful in converting a barren land into a lovely region of cultivated fields, with orchards, flower-gardens, and pleasant residences. There is now a very large admixture of "Gentiles," as they call non-Mormons, and the old exclusiveness is fast disappearing. See MORMON; SALT-LAKE CITY; UTAH.

GREAT SALT-LAKE CITY. See SALT-LAKE CITY.

GREAT SEAL. Since the union of England and Scotland all public acts of state, such as writs for summoning Parliaments and treaties with foreign states, have been sealed with one great seal of the United Kingdom of Great Britain. The lord chancellor is the keeper of the great seal. Another seal is used in Scotland for sealing grants and writs affecting private rights there. The Act of Union with Ireland provides that acts relating to both kingdoms should be done under the great seal of the United Kingdom; but in other respects the great seal of Ireland is used as it was before the Union.

GREATEST COMMON MEASURE. See COMMON MEASURE.

GREAVES (French *grève*), pieces of armour which were worn as defences of the front of the legs. Originally they were made of hide or of quilted linen, but afterwards thin plates of metal were used. In the account given in the Old Testament of the armour of Goliath greaves of brass are mentioned, and this portion of the warrior's equipment is also frequently referred to in the Homeric poems. In the elaborate armour of the mediæval period greaves were often made of steel.

GREBE (Podiceps) is a genus of birds forming with the genus Colymbus the family Colymbidæ or DIVERS, In the genus Podiceps the head is narrow, the beak long,

pointed, and sharp, somewhat compressed at the sides, and slightly inclined upwards towards the tip. The neck is long; the tail is wanting. The toes, instead of being webbed, are separate and flattened, having their edges fringed with a broad stiff membrane, each toe being in fact a beautifully formed paddle. Of the three anterior toes the outermost is the longest and broadest; the next is nearly as large, and its outer edge lies tile-like over the inner edge of the outermost; the innermost toe is less than the middle one, on which its outer edge impinges. The hind toe is short, placed high on the tarsus, and furnished with a lobated membrane. The arrangement of the scales covering the toes gives them a leaf-like appearance, for the lines dividing the scales run obliquely in regular succession from a central shaft, formed by the bones advancing to the tips, which are covered each with a broad flat nail. The tarsus is short, and much compressed laterally.

The grebes haunt the sea as well as lakes and rivers, and swim and dive with great address. So instantaneously do they plunge, that, unless when taken by surprise, the gunner has some difficulty in hitting them. They will make a stretch of 200 yards before coming up to breathe, which is done by merely raising the head for a second above the water. Fishes, frogs, and aquatic insects constitute their food. The stomach upon dissection is always found to contain a mass, greater or less, of feathers, swallowed by the bird while dressing its plumage.

From the changes in plumage to which the grebes are subject, and the difference between the young and adults, the older writers fell into many errors respecting the

Head of male Eared Grebe, in summer plumage, and foot of the same.

species. Some species during the breeding season are adorned with elegant silky plumes about the head or throat, and it is from the position of these that the horned grebe, the eared grebe, and the crested grebe take their respective names.

The grebes build their nests among reeds and dense aquatic herbage; the nest is composed of a mass of half-decayed roots, dried flags, &c., and floats on the water so as to rise or fall with the tide or swell and subsidence. The eggs are three or four in number, and are carefully covered up by the female every time she leaves the nest.

Two species of grebes are resident in this country, the great crested grebe and the little grebe. The Great Crested Grebe (*Podiceps cristatus*) is an inhabitant of most of the northern parts of both hemispheres. It measures from 21 to 22 inches in length, and has the plumage of the upper surface dark brown, and that of the lower parts white; the wings exhibit a white patch formed by the secondary quills; the top of the head is dark brown, and is adorned at the back with a double crest of the same colour; the cheeks are white, and below the head there is a sort of tippet, hanging down all round the neck, of a pale chestnut colour, deep chestnut at the lower margin.

The Little Grebe (*Podiceps minor*), also called the Dabchick, and in some places the Didapper, is the smallest British species of this family, and is by no means uncommon in this country throughout the year. It is widely distributed in the northern parts of the Old World, but is not found in America. The little grebe measures only $9\frac{1}{2}$ inches in length, and is nearly black above and grayish-white beneath, with the cheeks and upper part of the neck reddish-chestnut. It frequents rushy lakes and ponds during the summer, but in winter resorts to small streams, and when the weather is severe even to estuaries and sheltered parts of the sea-coast. Its food consists of small fishes, insects, and other aquatic animals: and its nest, which contains from four to six eggs, is of large size, and placed among the reeds and rushes which fringe its place of abode.

Other species of grebes visit this country in the winter, as the Eared Grebe (*Podiceps nigricollis*), a southern form, and the Horned Grebe (*Podiceps auritus*), which breeds in Iceland. Several species are peculiar to North and South America.

GRECO, EL, painter, sculptor, and architect, whose real name was *Domenico Theotocopulo*, was a Greek by parentage, whence his (Spanish) name. He lived from 1548 to 1625. He studied under Titian and Tintorello at Venice, and afterwards settled at Toledo in Spain in 1577. Here his great works are, and those who have not had the privilege of seeing them there do not know the power of El Greco. If there were no other attractions in the grim old Spanish Gothic city, these would alone reward the pilgrimage thither. The famous "Burial of Count Orgaz" in the Church of Santo Tomé, and the "Parting of Christ's Raiment," are very noble works. A small picture added to the National Gallery from the Hamilton sale in 1883 as a Titian (a portrait of Louis Cornaro, absurdly so styled) proved to be a Greco, and is the only specimen we have. His work is very extraordinary—in fact the man was in later life eccentric to the verge of lunacy—but it is as genuinely original and as weird and ghostly as that of our own Blake. (Blake was undoubtedly not always perfectly sane.) Irregular and capricious as he often is, El Greco at his best never fails to fascinate the connoisseur. His architecture is in the antique style, but quite devoid of all extravagance. It cannot be pronounced successful. There is no doubt that the many works of El Greco found in Spain moulded the taste and style of Velasquez. The love of homely Spanish faces, even in somewhat incongruous surroundings (as representing Jesus, Mary, &c.), is a great characteristic of El Greco; but in their use, while aiming at naturalness of effect, he never becomes vulgar for a moment. Philip II., a great patron of his, justly remarked that in colour he sometimes equalled Titian.

GREECE, ANCIENT, lay between 36° and 40° N. lat. It was bounded on the north by Illyricum and Macedonia, from which it was separated by an extensive range of mountains. It may seem odd to the general reader who has memories of Alexander the Great, to exclude Macedonia, but even the slender claims Macedonia may have to be considered Greek in the time of Alexander, whose father had done his utmost to Hellenize it, cannot stand a moment's examination. Then, as at other periods, it was rightly regarded as *barbarian* (*i.e.* foreign, not necessarily savage).

The name *Greek* is sometimes said to come to us from the Latins, which in a narrow and literal sense is perfectly true. The reader of Hesiod (Eoai) will remark, however, that *Græci* (Graikoi) is frequently used as a collective

name for the race. and Hesiod is the most ancient Greek writer but one. In the most ancient writer of all, Homer, the collective term is *Achæans* (Achaioi), a designation limited after Homer's day to one race in the Peloponnesus, just as Greeks (Graikoi) became limited to a tribe in Epirus. The inference is clear; the Italians became acquainted with the Greeks as a general body after they had ceased to call themselves Achæans and before they had begun to call themselves *Hellenes*, while indeed they were yet Greeks to themselves as well as to others. The name Hellenes appears even in Hesiod to be the favourite, and quickly became universal. The modern Greeks wisely keep to the ancient title, and he whom we call King of Greece is truly the King of the Hellenes.

The peninsula of Greece extends in a long rhomboid shape from the mainland of Europe, leaning towards the south-east, the eastern side of this rhomboid being cut by a narrow channel so as to split off the long island of Eubœa, and the southern edge of it almost entirely sea-washed by the Corinthian Gulf and the Saronic Gulf. But between these two gulfs is the narrow isthmus of Corinth, at one place only 5 miles across; and hanging by this stalk is the mulberry leaf, as moderns call it, the *Morea*, which the ancients called *Peloponnesus* (the island of Pelops), roughly speaking about half the size of the rhomboid above mentioned as forming the mainland. Peloponnesus is thought by us to resemble a hand rudely sketched quite as well as a leaf, whether mulberry or any other. The sea bathing this fruitful land of Hellas is called the Ionian Sea on the west, the Ægean Sea on the east.

Stretching across the top of Hellas were Epirus under Illyricum on the west, Thessaly under Macedonia on the east—the two together reaching from Ionian to Ægean, and beneath these comes a row of states bordering the Corinthian Gulf, namely (reckoning from the west) Acarnania, Ætolia, Locris, Phocis, and Bœotia (Thebes). Across the channel, to the extreme east of this row of states, lay Enbœa. A small state, the Opuntian Locris, bordered the channel on the mainland side, cutting off all Phocis and part of Bœotia from the Eubœan channel, and touching the south of Thessaly with its northern extremity. Opuntian Locris lay between the mountains and the sea, and at this northern end of it a narrow pass (Thermopylæ) gave the only good access from Thessaly into Lower Greece. Thessaly was cut off from Ætolia and from Phocis by practically impassable mountains.

The state of Corinth, with that of Megaris, occupied the isthmus, and lay across from one gulf to the other. The important state of Attica, that is of Athens, touching both Bœotia and Megaris, formed the northern shore of the Saronic Gulf; the state of Argolis, touching Corinth, formed its southern shore; and the island of Ægina lay in the midst of the gulf between them. Argolis (Argos) had also about 10 miles of sea-board on the Corinthian gulf. The Peloponnesian states were Achaia and Argolis to the north (on the gulf), Elea on the west, Messenia on the south-west, Laconia or Lacedæmon (Sparta) on the south-east, and Argolis on the east, the Swiss like mountainous Arcadia lying in the very heart of the land. A full degree to the south and west lay the great island of Crete. All the islands in the Archipelago, and also all the shore line of Asia Minor, were Greek too, and the southern portion of Italy, together with a great part of Sicily, were so thoroughly Greek as to be called Great Greece by both Latins and Greeks alike. A few Greek cities, such as Marseilles, Antibes, Nice, &c., studded the southern shores of Gaul. The whole area of ancient Hellas (Greece, the islands and the Asian shore) was as nearly as possible that of Scotland, perhaps somewhat more; and the extremely mountainous character of most of the land renders the comparison not inapt. As to its population, according to an estimate of Clinton ("Fasti Hellenici," vol. ii. p. 386), in which he includes the population of the islands of Eubœa, Corcyra, Leucadia, Ithaca, Cephallenia, Zacynthus, Cythera, Ægina, and Salamis, Greece contained a population of more than 3,500,000 inhabitants from the time of the Persian wars to the death of Alexander the Great. Greece, including the islands already named, contains about 22,231 square miles; consequently there were rather more than 157 persons to the square mile, a rate of population very little inferior to that of Great Britain in 1821, which contained 165 persons to the square mile.

History.—The first period of Grecian history may be conveniently considered as extending from B.C. 1184, the supposed date of the siege of Troy, to B.C. 776, the date of the first Olympiad. This obscure period, or at least the greater part of it, lies beyond the limits of genuine history. It is preceded by the mythological and heroic ages, of which a brief account is given in the article MYTHOLOGY.

The Hellenes never considered themselves the original race. They called the original people Pelasgians, and massive constructions of this primeval race were known to them even in greater abundance than the relics we now possess. The Hellenes were believed to be Thessalian in origin. The truth is, of course, that the Hellenes were a branch of the westward travelling Aryan hordes which had entered Europe with the main body from the plateaus of Central Asia and diverged southward into the peninsula of Greece, which perforce they must have entered by Thermopylæ (*i.e.* by Thessaly). The Hellenes divided themselves into Ionians, Dorians, and Æolians, the Athenians and the cities of Asia being the culminating race of the first, and the Spartans of the second. The three divisions differed much in linguistic peculiarities and in general characteristics. The Æolian is taken to be the nearest to the original stock. The first general Greek expedition (excluding that of the Argonaut heroes) was the famous Ten Years' War against Troy, a city in the north of Asia Minor. Troy fell B.C. 1184. Fifty years later the northward lying Thessaly was thoroughly subdued, and thirty years later still the Dorians, leaving their home at the foot of Parnassus, to the north of Phocis, and headed by three descendants of Herakles (whose family had been driven out of their kingdom in the Peloponnesus a century before), crossed the mouth of the Gulf of Corinth, and in B.C. 1104 (so say Thucydides and Apollodorus) rapidly overran the peninsula of the Peloponnesus. This is the famous return of the Herakleids, and gives the date of the legendary formation of the three states of Messene, Sparta, and Argos. Dorians were up till now so obscure as to be unknown to Homer, &c., a fact telling certainly in favour of the legend of their sudden rise to power.

This resumption of power by the Herakleid princes (descendants of Perseus) dispossessed the Pelopids (descendants of Pelops), who accordingly led a large body of Æolians through northern Greece and Thessaly into Thrace (modern Roumelia), whence they crossed the Bosphorus into Asia and founded the great Æolian cities of the north. They also founded the state of Achaia along the north of Peloponnesus. Then also the Ionians (descendants of Neleus) were dispossessed at the same time, and these seized upon Attica, already peopled by the Ionian race, as their home. The last king of Athens of this Neleid dynasty was Codrus; and when the Dorians later on advanced against Attica, he rushed upon their spears, relying upon an oracle which had declared victory to that country which should first lose its king, B.C. 1045. The Athenians so honoured his memory that they never afterwards suffered the name of king to be borne. The descendants of Codrus were called instead *archons* (rulers); and when Ionians, refugees from Dorian harshness, crowded the state, one of these Codrids undertook to lead an emigration to Asia across the Ægean. All the great islands, and ten great cities on the mainland of Asia Minor (west and south),

became Ionian, and all looked to Athens as their "mother city" (*metropolis*). The Dorians also colonized Cos, Rhodes, and Crete. Argolis, Laconia, and Messene were the chief Dorian states in the Peloponnesus.

The second period extends from B.C. 776 to the commencement of the Persian wars, B.C. 500. The two states of Greece which attained the greatest historical celebrity were Sparta and Athens. Of the two the power of Athens was of later growth. Sparta had, from the time of the Dorian conquest of the Peloponnesus, in the eightieth year after the Trojan War, taken the lead among the Peloponnesian states, a position which she maintained by the conquest of the fertile country of Messenia. This conquest took 300 years to fully accomplish, ending B.C. 455. Her superiority was probably owing to her political institutions, which are said to have been fixed on a firm basis by her celebrated lawgiver Lycurgus, B.C. 884. At the head of the polity were two hereditary chiefs called "kings," but their power was greatly limited by a jealous aristocracy. Five *ephors* annually elected watched over the conduct of the citizens, even of the kings themselves. Their despotism equalled that of the Venetian Council of Ten. The original inhabitants of Laconia were made slaves of the state (not of individuals), and treated very harshly; they were called *helots*, and did all kinds of work for their masters, who formed a military aristocracy. They were not personal property, and could not therefore be removed or sold. Sparta's territories were also increased by the conquest of Tegea in Arcadia. Athens only rose to importance in the century preceding the Persian wars; but even in this period her power was not more than a match for the little states of Megaris and Ægina. The city was long harassed by intestine commotions, till the time of Solon, B.C. 594, who was chosen by the citizens to frame a new constitution and a code of laws.

In the sixth century before the Christian era, Greece rapidly advanced in knowledge and civilization. Literature and the fine arts were already cultivated in Athens under Pisistratus, who had seized upon the government of Athens, B.C. 560. Such a ruler was called a tyrant, but the word had not then the odious signification it now bears. It simply meant dictator. There were good tyrants as well as bad ones. The Pisistratids (sons of Pisistratus) were driven out by a revolution helped by Sparta and headed by a wealthy and influential family, the Alcmæonids, in 510; and the reforms of Cleisthenes, one of the Alcmæonids, soon raised the republic of Athens to very great power. The envy of Sparta at once showed itself in an invasion and temporary occupation, and a never-dying hatred set up between the two states. Among the reforms of Cleisthenes was the remarkable device of ostracism, for the banishment of over-powerful citizens for ten years by the vote of the people.

The third period of ancient Greek history comprehends the time from the beginning of the Persian wars, B.C. 500, to the accession of Alexander the Great, B.C. 336. It was, especially in its earlier stages, the most splendid period of ancient Greece, and has probably received more attention than any other period of the world's history. Politics, literature, and art reached their most interesting development, and models in each were set up by this wonderful people which have served the civilized world ever since. The first division of this period, the Persian wars, arose thus:—Crœsus, king of Lydia (whose wealth and power were so great as to have passed into a proverb), had conquered all the Greek colonies in Asia Minor. Crœsus himself fell before the Persian conqueror, Cyrus the Great, B.C. 546. Darius, a Persian nobleman, was made king on the failure of Cyrus' line, B.C. 521, and at once invaded Europe, conquering Thrace (European Turkey), which lay nearest to his hand. The Æolian Greek colonists watched his bridge of boats over the Danube. Miltiades, an Athenian, who was tyrant of part of Thrace, desired to cut off the retreat of Darius by destroying this bridge, but was prevented by the other chiefs. Thus was lost an opportunity never again offered. A series of insurrections on the part of the Ionian Asiatic cities arose, and Darius after his return to Asia learned that Sardis had been burnt by the insurgents with the help of Athens and other Greeks from Hellas proper. Greatly incensed, he sent his nephew and son-in-law Mardonius through Thrace to chastise these Hellenes, B.C. 492. Datis and Artaphernes led a second expedition in B.C. 490, and crossed the Ægean direct, landing at Marathon in Attica, under the guidance of Hippias the Pisistratid, the former tyrant of Athens, exiled as said above in 510. At the great battle of Marathon, Miltiades with a force of 9000 Athenians and 1000 Platæans, routed the Persian host of at least 30,000. A deep revenge was of course to be looked for. Themistocles, now rising to power in Athens, prepared the state against the expected attack by creating a navy, founding thus the splendid Athenian naval empire. Aristides, perhaps of less genius, but of infinitely nobler soul than Themistocles, was ostracized during this period. The son of Darius, Xerxes (king of Persia in 485), was ready by 480 B.C. with the long-prepared armament. It is said by Herodotus to have numbered 2,500,000 soldiers and the like number of attendants. Other authorities, but none so near the period as Herodotus (who had conversed with eye-witnesses), put it at 1,000,000. The whole world was astounded and terror-stricken at its vastness, whatever the exact figure may have been. Xerxes crossed the Hellespont by a bridge of boats, and marched through Thrace, Macedonia, and Thessaly, being joined by the Greek states as he passed by. Thermopylæ was blocked, however, by the Spartan Leonidas and 300 men, with 700 Thespians also. Traitors showed the Persians how to turn their flank by mountain paths, but the defenders preferred to perish rather than surrender. Xerxes advanced on Athens and burnt it, the Athenians retiring as warned by the oracle of Apollo at Delphi. The fleet was at Salamis under Themistocles, and they thought this to be the "wooden wall" on which the oracle had told them to rely. The Persian fleet was hopelessly defeated in the ensuing engagement, and Xerxes returned to Asia in mortification, hurrying along in what was almost a flight, and leaving Mardonius with a part of the host to carry on the war, B.C. 480. Pausanias of Sparta was the Greek land-general, and in a battle at Platæa defeated and slew Mardonius, B.C. 479, Aristides taking part in the engagement with the Athenians. The great host retired; Athens rebuilt her walls, assumed the naval supremacy of Greece, and became all-powerful. Themistocles, cruising among the island allies, was later on accused of having treasonous relations with the Persians, and was ostracized. He fled to the Persian court, and arrived there in B.C. 465, just as Xerxes was assassinated. He lived some years in great honour and considerable wealth with the new king Artaxerxes, and was planning to lead him to his revenge in Greece when he died. A contrast to this was offered by the death of his old rival Aristides in great honour, but so poor that there was not enough of his own to pay his funeral.

To show the justice of Aristides it must be said that when the confederation of Delos was entered into, B.C. 477, whereby all the Greeks contributed to a naval armament under the presidency of Athens, he arranged the contributions so accurately that the astonishing result was attained of all the states being satisfied with his award. Athens soon managed under Cimon, the son of Miltiades of Marathon, to convert this headship into a sovereignty; the treasury was moved to Athens from Delos, B.C. 459, and the money was used for Athenian ends, the former allies becoming subjects. Athens also was supreme over Bœotia and Phocis, Argolis and Achaia, &c., as well as the islands,

at this time. But a defeat at the hands of Bœotian insurgents at Chæronea in 477 put an end to this supremacy of Athens on land. The supremacy at sea was retained for long after, and was greatly aided by the famous "long walls," connecting Athens with her port of the Piræus, and rendering the city almost impregnable.

The age of Pericles now succeeded, 460–430, and Athens rose as high in literature and the arts as she had done in political prestige. Pericles was no tyrant, but his commanding presence inspired the democracy with one mind. The Parthenon arose, and Phidias produced those masterpieces of sculpture whose fame has remained through all time. Pericles firmly believed that the proper way to maintain Athens at the head of Greece was to make her more noble and more cultured than the inferior states. He practically threw open the theatre to the people, and the drama rose to great excellence under his fostering care. Unhappily, where so much depends on one man, even a patriot like Pericles, his death shakes the whole fabric. The state, which had not had time to consolidate its new greatness, almost at once fell from its high position.

The mutual jealousy of Athens and Sparta caused the long war of twenty-seven years between them and their adherents (B.C. 431–404), called the Peloponnesian War. Pericles died at its commencement, B.C. 429. Cleon (the butt of Aristophanes) succeeded to power by demagogic arts. Brasidas opposed him on the Spartan side. A crushing disaster befell the Athenian expedition to Syracuse in 415. Yet this is the palmy period of Greek drama and philosophy. Socrates, Plato, Æschylus, Sophocles, and Euripides flourished. The spirit of the Athenians restored their fortunes for a time; but domestic dissensions and changes of government eventually dragged them hopelessly down before the persistent attacks of the Spartan Lysander. The war terminated by again placing Sparta at the head of the Grecian states, a position which in time created the same jealousy of Sparta which had formerly existed with respect to Athens. The Corinthians, Thebans, Argives, Athenians, and Thessalians then combined to throw off the Spartan dominion. The confederates were not, however, successful in the attempt; and the Spartan supremacy was again secured for a brief period by a general peace made by Persian intervention, B.C. 387, usually known by the name of the peace of Antalcidas.

Returning again to just before the close of the Thirty Years' War (404), the changes at Athens spoken of were, first, the reforms of Peisander, the government by an oligarchy of Four Hundred, with a restricted constituency of Five Thousand; then the seizure of power by the Five Thousand, too late for successful resistance to Sparta, however; then the bloody tyranny of the Thirty Tyrants named by Lysander as governors of the prostrate city. These men tried to reduce bright and polished Athens to Doric rudeness, striking at liberty of body and of speech. One of their victims was the noble Socrates. Another was the exiled Alcibiades, the termination of whose adventurous life by assassination at Persian hands they procured. Eventually they were first reduced to ten, and then finally overthrown and the democracy restored, 403. [See FIVE THOUSAND, FOUR HUNDRED, THIRTY TYRANTS, &c.] In 401 occurred that splendid and ever memorable expedition or ANABASIS of the 10,000 Greeks to assist Cyrus in his attempt against the Persian throne, then filled by his brother Artaxerxes, ending in the defeat and death of Cyrus at Cunaxa, near Babylon, and the retreat of the Greeks through a hostile country to the Greek shores of northern Asia Minor. Xenophon, the pupil of Socrates, was one of the chief commanders during the retreat, and wrote a history of the expedition almost without parallel for beauty of style and for interest. The main result of this retreat was to show the weakness and disorganization of Persia, and to arouse in Greek bosoms wild thoughts of taking revenge for the invasions of Darius and Xerxes—a sentiment skilfully fanned into a flame by the great Macedonians a few years later.

In 382 the treacherous admission of Spartans into the *kadmeia* (citadel) of Thebes by its governor caused an insupportable hatred of Sparta among the Thebans, who rose in 379, reconquered the citadel, and began a general war, with the assistance of Athens, against the rest of Greece. This ended in the great victory of Epaminondas at Leuctra. The genius of this noblest of all the Greeks at once raised his county to the headship of Greece. Athens, Sparta, and Arcadia joined against Thebes. Epaminondas marched into Peloponnesus, gained a complete victory at Mantineia, but unfortunately was wounded in the encounter, and died on the field (362). With him perished the importance of Thebes. Thus in turn Athens, Sparta, and Thebes had dominated Greece. Each had been effectually crippled by the others, and the whole land now lay exhausted and almost helpless. Sparta was so desperately poor that the aged King Agesilaus led a body of Spartans as hired mercenaries against Egypt under the Persians, to earn some money for the state! Athens was so weak that the allies or subject states so long oppressed by her easily threw off her yoke in the Social War, 357–355.

The barbarous, half-savage state of Macedonia was now ruled by probably the most capable Greek in all history, the famous Philip, who ascended 359. He deliberately set to the task of conquering the neighbouring land of Greece, and himself took every pains to invite Greeks to his court and learn all available arts and sciences from them. Thus Aristotle became under Philip the tutor of Alexander the Great, Philip's son. His designs were pierced by Demosthenes, but he had taken care to obtain the assistance of Æschines, second only in oratorical power to Demosthenes, though infinitely his inferior in statesmanship and in patriotism. By lavish bribery, by every trick and artifice, and by plausible promises, Philip got together a large party in Athens and other states. A sacred war against Phocis, which had cultivated the lands belonging to the shrine of Apollo, not only completed the exhaustion of Greece, but gave Philip the excuse to interfere. He ended the struggle, and in return was elected head of the Amphictyonic council (or general religious union of the states), and thus claimed to be the head of Greece. Athens resisted for some time yet, but at Chæronea (338) she was entirely crushed, and Hellas lay at Philip's feet. To unite his newly conquered country Philip proposed to engage in the overthrow of Persia; but while armaments were preparing he was assassinated in a private quarrel, and his son Alexander succeeded, 336 B.C.

We have now reached the fourth period of the history, the brief but splendid empire of Alexander the Great, 336–323. This is almost a personal record, and is as such elsewhere fully described. The young king set off for Asia almost at once with the army so splendidly trained and organized by Philip, first destroying Thebes utterly, to punish it for taking advantage of the troubles at his accession to revolt, 335. The battles of the Granicus, 334, and of the Issus, 333, laid Persia open to him, and that of Arbela in 331 completed the conquest. King Darius, flying for his life, was assassinated by one of his own satraps, Bessus. No doubt Bessus thought that Alexander might make use of Darius to more easily gain the country if he could take him alive. But Persia was only part of Alexander's designs. He overran Egypt, founded Alexandria (332), and visited the temple of Zeus Ammon, where an oracle revealed to him that Zeus, and not Philip, was truly his father. From Persia he pushed forward to India, and in 327 defeated Porus, king of northern India. His army refused to go further, and he was forced to return after sailing down the Indus, amid perpetual fighting, to the Indian Ocean. He now adopted Oriental

styles, received adoration in the Persian manner, married many wives, and proposed to live at Babylon as the centre of his vast empire. But a sudden fever carried him off at the early age of thirty-three, 323. It must be remembered that Alexander was not a true Greek, nor were his aims Hellenic. He evidently was fast drawing to an Oriental despotism, and had, in fact, before his death already trained Eastern mountaineers into a fine body of troops, so that he was no longer dependent even upon his own Macedonians.

The final period of ancient Greek history is now reached —that slow decay from the death of Alexander (323) to the conquests by Rome, the first of which was in 197 and the last in 146 B.C.

At the great king's death his generals, whom in the Persian fashion he had made satraps over provinces, quickly turned their satrapies into kingdoms. The mother and first wife of Alexander vainly sought to retain Greece for his infant son. Athens and other states of course revolted, but were overpowered by the regent Antipater. Many perished from his revenge, or committed suicide from despair, or to avoid torture or imprisonment, Demosthenes taking poison among the number. A subsequent revolt against Cassander, son and successor of Antipater, under the upright Phocion, only resulted in the death of the patriot and the utter ruin for ever of Athens. Cassander now assumed the title of king, and reigned over Macedon and Greece till the rise of the great Pyrrhus, king of Epirus (so well known in early Roman history), who drove him out, 286. In 280 the immense host of the Gauls overran Macedon, and in the next year they forced Thermopylæ and invaded Greece. Like the Persians they failed in an attack on Delphi (of course attributed by the Greeks to the protection of the god Apollo), and large numbers of them fell in their retreat. Many, however, crossed into Asia, and settled down eventually in Galatia.

When Pyrrhus was slain at Argos, 272, Macedon once again took the lead in Greece; but its despotism was now checked by the rise of the Achæan League, founded 280. Eventually this league, at first almost limited to Achaia, was joined by practically all the states of Greece but Sparta. The great statesman Aratus is the hero of this time, and his efforts to raise Greece by means of the league were so successful that Philip II. of Macedon (ascended 220) caused him to be assassinated in 213 B.C.

The war between Rome and Carthage was at its height, and Philip entered into correspondence with Hannibal, which the Romans discovered in 215. Accordingly, as soon as Carthage had fallen war was declared against Philip on the first pretext to hand, 200. The Ætolian and Achæan leagues at once joined Rome, and at Cynoscephalæ, 197, T. Quintius Flamininus defeated Philip utterly. At the Isthmian games in the following year Flamininus by a herald proclaimed the freedom of all Greece from the tyranny of Macedon. Philip's son, Perseus, succeeded at his death in 179, and at once prepared for the expected war with Rome. It broke out (171), and ended in his complete overthrow at Pydna, 168, and the division of Macedonia into four states by L. Æmilius Paulus. When Carthage made her last struggle for freedom Macedon, too, revolted. Q. Cæcilius Metellus (called Macedonicus) easily quelled the rising; and the ruthless C. Mummius (called Achaicus) took and burned Corinth and harried the south of Greece, B.C. 146. Greece now, under the name of Achaia, became a Roman province.

For the second political epoch of Greece, when the tide of power rolled again eastward from Rome to Constantinople, see GREEK EMPIRE; and for the third epoch, the present kingdom of the Hellenes, see the subsequent part of this series of articles, that on GREECE, MODERN.

Art.—The art of ancient Greece was almost entirely devoted, so far as we know it, to its religion. Ancient Greek music remains to us only in three temple hymns discovered by Vincenzo Galilei (father of the astronomer) in manuscripts snatched from the hands of the destroying Turks in 1581. Even its large dramatic use (for the choruses were sung with a slow rhythmic dance, or perhaps we should more correctly say, were chanted) was wholly in its origin, and as anyone can see by referring to the tragedies, largely to the very last religious. [See GREEK DRAMA.] The effect of the music of TYRTÆUS is discussed elsewhere. The art of painting is known to us actually in its Greek use only by painted vases, and by a few scraps of colour adhering to the temple walls; but we have a tolerably good hearsay account, and we may eke this out with what we see at half-Greek Pompeii. It was also almost exclusively religious. There remains the art of sculpture, and here the glorious statues of the gods and heroes of Greece almost exhaust the subjects preferred. A few portrait busts and a very few statues remain also, but their number is quite limited. To rightly sympathize with the wonderful Greek antique statues one must be penetrated with the spirit of the classic mythology, a subject which is elsewhere fully treated of [see MYTHOLOGY]. The equally noble GREEK ARCHITECTURE is treated of in a separate article.

It is no doubt this close interconnection of art and religion which gives that sublimity to Greek æsthetic ideals that all men feel who contemplate them sympathetically. There is more than the mere stone before us in the Parthenon or the Aphrodite of Melos, or the Apollo of the Belvedere; there is a touch of the divine—something never since attained, except by some few Italian painters and mediæval (Gothic) architects who worked in the same emotional element. We feel that we are in the presence of something eternal and beyond us when we see these unapproachable works. Others which have perished we are told by the universal voice of antiquity were far finer than these. We instance the great statue of Zeus at Olympia 60 feet high, executed by Pheidias, immediately preceding the Peloponnesian War. It was too precious for marble to enshrine, the costly ivory therefore was its material, and the drapery was of solid gold. For centuries it continued to awe and impress the whole ancient world; probably no work of art ever was equally potent over the minds of men.

When Marcellus, in 212 B.C., brought home to Rome valuable Greek pictures and statues from Syracuse, the graver citizens accused him of corrupting the Roman peoples trained solely to war and agriculture. But the people upheld Marcellus, and next year the taking of Greek Capua yielded more of the sweet poison by Flaccus' aid. Flamininus made Philip of Macedon disgorge plunder of artistic kind taken from many Greek cities in 197 B.C., and nine years later more than 500 bronze and marble statues were sent to Rome, the booty of Ambracia, the capital of Pyrrhus, by Fulvus Nobilior. Cornelius Scipio in 190 stripped Magnesia, and Æmilius Paulus followed him in Achaia. Finally Caius Mummius left nothing but rude and ancient statues behind at Corinth, B.C. 146. It is to these spoliations that we owe in great measure the preservation of the relics we possess, for everything left in Greece has gone.

A few notes on Greek painting may now follow. The rough vase-paintings in white, red, or yellow, on a black ground, with their figures treated in a conventional manner, and the decorations (probably Greek) at Pompeii done by common house-painters from a few stock models for the most part, are yet so full of fine qualities that the thought of what the really artistic paintings must have been is most tantalizing. One or two noble designs in mosaic, indeed, remain to show that our loss has been very great. The Greeks painted their temple walls and house walls in fresco; and their movable or easel pictures were in tempera, or in the

later period in encaustic or wax-painting. The chief artists, known only by repute, are as follows:—Polygnotos, in the age of Pericles, decorated the temple at Delphi among other great works (about 450 B.C.), and his somewhat archaic style was improved upon by Apollodoros of Athens, famous for his mastery over colour and shadow. His pupil was the famous Zeuxis of Herakleia, on the Euxine (425 to 400 B.C.), who, by adding finish of execution, inaugurated the great period of Greek painting. His rival, Parrhasios of Ephesus, was almost his equal. They met in frequent trials of skill. When the birds pecked at the grapes painted by Zeuxis, the judges considered that he must have vanquished; but when Zeuxis himself impatiently asked Parrhasios to determine the contest by drawing aside the curtain which continued to hide his picture, the judges hesitated to decide. Zeuxis had deceived birds, but Parrhasios had deceived an artist—the curtain was the picture itself. The art still further flourished under Macedonian auspices. In Alexander's time flourished Aristides of Thebes (360-330 B.C.), for one painting of whom Attalus, king of Pergamus, long afterwards deemed 600,000 sesterces (about £6000) not too high a price to pay. His contemporary, Apelles of Colophon, was greater still; and ancient literature draws an enticing picture of his Aphrodite Anadyomene, when the goddess was seen rising from the sea, the water dripping from her hair and shrouding her in a veil of glittering drops. His portrait of Alexander as Zeus grasping the thunderbolt was renowned throughout antiquity. After the Macedonian period Greek painting rapidly declined, and became cold, mechanical, and full of mannered repetition.

We are happily not dependent on hear-say for our knowledge of Greek SCULPTURE. In the article of that name further remarks are offered. It is sufficient here briefly to trace the outlines of its history in Greece. As has been said above Greek sculpture is an attempt to render visible the spirit of the religion of this people of artists by means of forms of visible beauty. Even before 490 B.C., the epoch of the Persian wars, sculpture existed in Greece; but its features were archaic and stiff, as enough examples remain to prove. Yet fine elements are found even in this stiffness. From 490 to 400 B.C., the time of the splendour of Athens, was the golden time of sculpture. At its commencement we find Kalamos still tinged with archaism, as his fine statue of the seated Penelope at Rome shows, and contemporary with him Ageladas of Argos. This latter trained the three greatest sculptors of the world, the glory of the era of Pericles—viz. Myron, Pheidias, and Polyklêtos. The Discobolos of the first, the head of Zeus (copied from the colossal statue of Zeus at Olympia) of the second, and the Diadumenos, the Hera, and the spear-bearer (Doryphoros) of the third—the last called the *canon*, because its proportions were so perfect that they ever after served as a canon or rule—all remain now at Rome to prove the praises of the ancients no empty boast. Myron was the poet of motion, Polyklêtos of beauty, Pheidias of supreme majesty. Pheidias alone reached to the full the ideal of the father of Olympus, the great Zeus —a perilous subject to attempt truly. Besides the Zeus the colossal ivory and gold statue of Athena in the Parthenon at Athens was the work of Pheidias, who also designed the Parthenon and its approaches. The colossal bronze statue of Athena, the tip of whose spear was the topmost point of all Athens, was also by Pheidias, as well as a third statue of the same goddess, also on the Acropolis. His pupils, Alkamenes, Agorakritos, and Kolôtês, were renowned; and the most beautiful statue in the world, the Aphrodite found in the island of Melos in 1820 (the VENUS OF MELOS now at Paris), is believed to be a copy of a statue by Alkamenes. The sculptures of the school of Pheidias on the walls, &c., of the Parthenon (in the British Museum) are also very noble. Meanwhile at Argos Polyklêtos founded a school equally famous in its day, but well authenticated examples of which are rare.

The period from 400 to the death of Alexander (323) must be admitted to show signs of over-refinement and of decay, but as yet these signs are no more than indications happily. Thus we get the fine work of Kephisodôtos of Athens (pupil of Alkamenes), to whom the famous "Wrestlers" of Florence is due; the magnificent Niobe group of Skopas of Paros (now at Florence), the renowned Apoxyomenos (wrestler scraping himself), and the Sophocles-portrait of Leukippos (both at Rome), and the exquisitely beautiful creations of Praxitelês, the "Aphrodite" of Cnidos, the "Kallipyge," and the "Eros," and a few others of which we are fortunate enough to possess good copies. As to the value set by Greeks themselves on these works it is sufficient to say that the island city of Cnidos being hopelessly in debt, Nicomedes offered to pay off everything in exchange for the statue, and his offer was unhesitatingly declined!

In the final period of Greek sculpture, from the death of Alexander to the incorporation of Greece into the Roman Empire (146), we find the dignified restraint of the first period entirely thrown off. Effect and motion are now aimed at, very nobly, it is true, but the ideal repose of Pheidias and Polyklêtos is no longer with us. The superb "Dirke Tied to a Bull" of Naples (or the "Farnese Bull"), by Apollonios and Tauriskos of Rhodes, the bust of the dying Alexander (at Florence), the matchless "Laocoon" (at Rome) by Agesander, Athenodoros, and Polydoros of Rhodes, as well as the admired statue of the "Dying Gaul" ("Dying Gladiator," as it used to be absurdly called) which ornaments the capitol at Rome, are also of this period, coming from the school attracted to Pergamus by the art-loving King Attalus in the third century B.C. This pathetic statue is worthy of the finest period. In true Greek spirit, though actually in repose, it indicates action both already past and yet to come. It is one of the last, as it is one of the best, productions of Greek art.

GREECE, LANGUAGE AND LITERATURE OF. See GREEK LANGUAGE AND LITERATURE.

GREECE, MODERN, KINGDOM OF. *Physical Geography, Climate, and Productions.*—The modern kingdom of Greece, constituted in the year 1832, does not exactly correspond in its dimensions to ancient *Hellas*. It embraces the south extremity of the peninsula occupied by Turkey through the greater part of its extent, and is washed by the Ægean Sea on the east, the Ionian on the west, and the Mediterranean on the south. The northern boundary, as fixed by the Constantinople conference of 1881, begins on the marshy northern shore of the Gulf of Arta. Here it is formed by the Arta River, which flows into the gulf from the north, and divides Epirus longitudinally into two unequal parts, the lesser of which is now Greek territory. At Politza it leaves the Arta and follows the course of its tributary, the Kalarrytes, which flows in from the north-east. From Kalarrytes, a small place on the river of the same name, it goes almost in a straight line to the summit of Mount Peristeri, a bold peak 7200 feet in height, and thence, by various ridges, to the head waters of the Salambria. Thence it runs almost due north (leaving the important strategical position of Metzovo to Turkey) for a distance of about 7 miles to a mountain called Mavronomni, and then turns sharp to the eastward along the watershed between the Salambria and the Vistritza or Heliacmon. Its course from Teluka passes the point of junction between the basins of the Salambria, Heliacmon, and Xeraghis, and follows the southern watershed of the Xeraghis basin towards Zarkos, whence it runs to Mount Kritiri, and after traversing the southern spurs of Mount Olympus, reaches the coast of the Ægean at a short distance south of Platamona. There are a multitude of islands closely adjoining the shores; but the total area of

the country, with the territory added in 1881, is only about 25,100 square miles. The coast line is more extensive in proportion to the size of the country than that of any other portion of the continent. No part of Greece is more than 40 miles from the sea.

Greece is in great part mountainous. The principal range is that of Œta, which, beginning at the east, on the coast of the channel of Eubœa, runs nearly due west across the country, joins the group of Mount Tymphrestus in Ætolia, and is only separated from the mountains of Acarnania and Epirus by the valley of the Aspropotamo. Offsets from the range of Œta connect it on the south with the ridge of Parnassus in Phocis, and with the mountains that border the northern coast of the Gulf of Corinth, while to the south-east are the ridges of Helicon, Cithæron, and Parnes, the last of which separates Bœotia from Attica.

The most important of the rivers are the Aspropotamo, or Achelous, which waters the western side of Northern Greece, and the Salambria. The former rises beyond the frontier, and discharges into the Ionian Sea, at the mouth of the Gulf of Lepanto. The Salambria, after rushing through the eastern gorges of the Pindus, wanders over the great plain of Thessaly, traverses the famous vale of Tempe, and falls into the Ægean. Of the other streams the Hellada or Spercheius, and the Gavrios or Cephissus, traverse the eastern side of the country. In the south are the Vasilipotamo or Eurotes, flowing through the plain of Sparta, and the Roufia or Alpheus, by the banks of which the great Olympic games were held. The mountains, and indeed nearly the whole country, are chiefly of limestone. It frequently assumes the form of marble of the finest quality and of various colours, which the ancients extensively quarried for buildings and statuary. No volcanic rocks are found on the mainland, but considerable masses occur in some of the islands, one of which, Santorin, is still a centre of volcanic action. Coal, sulphur, porcelain clay, salt, iron, and argentiferous lead, with some traces of gold, are among the minerals, but the extent and value of these resources have not been fully developed. Mineral springs, cold and warm, sulphureous and saline, are extremely numerous.

Though none of the mountains rise to the line of perpetual snow, yet it lingers on the loftier summits till the summer is far advanced, and speedily returns to them again. Hence very distinctly marked zones of vegetation are observed within a limited range, from the vine and olive of the plains and valleys to the beech and pine of the grand elevations. The olive grows wild in all parts of Greece, and under cultivation yields excellent fruit, which the inhabitants preserve in various ways as a staple article of food. The mulberry-tree is extensively grown for the silk-worms; oranges, citrons, lemons, pomegranates, almonds, and other fruits are largely produced; the figs of Attica are still, as aforetime, celebrated for their quality; and Mount Hymettus, in the neighbourhood of Athens, vindicates its ancient fame for aromatic plants, bees, and honey. In parts of the mainland and some of the Ionian Islands the dwarf grape or currant is the prime object of culture, extensively exported in the dried state to England. Greece produces about two-thirds of the corn required for its consumption. Wheat, barley, and Indian corn are the species cultivated; oats and rye are not in use. Tobacco thrives, especially near Argos and Calamata, and cotton is grown in considerable quantity. The vine grows luxuriantly, and is cultivated in the island of Santorin for wines saleable in foreign countries, owing to the volcanic soil being specially favourable to it. With the exception of a few spots, the entire island is now a vineyard, under the management of a company of experienced French wine-growers.

Horned cattle are not numerous, nor sufficient for the labours of the field, for which they are almost exclusively used, and oxen are imported for that purpose from Thessaly and Asia Minor. There are, however, numerous flocks of sheep and goats, which migrate to the mountains in spring, and return to the plains after the harvest. The produce of wool is considerable, but of a coarse kind, and is used chiefly for home manufacture. Pigs are scarce, except in Arcadia. The only milk used is that of ewes and goats, and the butter and cheese made from it are very inferior. Asses are chiefly employed as beasts of burden; the horses are of a strong breed, but neglected.

The fine forests with which the mountains were once clothed have been sadly wasted, and for the most part entirely destroyed, in great measure by the carelessness or wanton rapacity of the inhabitants themselves, and the mountains are now naked and barren, and the springs often dried up in consequence. The pine is the most common timber tree, but fine oaks are found in some of the mountainous parts. Along the frontier of the northern part of Thessaly, where the mountains are from 2500 to 5000 feet high, the shepherds burn freely the magnificent pine forests to obtain fresh pasture without any check or protest from the authorities.

Only one-seventh of the whole area of Greece is under cultivation; the rest, though in greater part good for agricultural purposes, lies waste. The ground is chiefly in the hands of a few proprietors, but many of the peasants hold small patches of land of their own. Others cultivate farms on the *metayer* system, the owner of the land providing the farmhouse, agricultural implements, and seed; the produce, after deducting the cost of the seed, is divided in certain fixed proportions between the cultivator and the owner of the land. A great part of the ground is national property, and the cultivator of it pays to the government as rent 15 per cent. of the produce. Much of this national property has also been sold to private individuals, to be paid for in yearly instalments of 3 per cent. on the cost price; and instead of paying the tithe or dime of the produce, the owners pay a property-tax of 3 per cent. per annum on a valuation of the land every three years.

The summer temperature is extremely high, but owing to the maritime position of the country the sea breezes have extensive prevalence and greatly modify the heat. The "black sirocco" is a hot southerly wind, which shrivels the vegetation and oppresses the animal system; but the west wind is light and humid, to which the ancients ascribed the production of flowers and fruits. Rain is, however, rare in summer, and clouds are not much more common. Abundant showers fall during the short winter upon the plains, while frost and snow are chiefly restricted to the higher uplands. The climate is very agreeable, the sky bright, and the atmosphere transparent. Sunset adorns the horizon with the most varied and gorgeous hues, which are reflected upon the objects below, and render the landscapes indescribably glorious.

Divisions.—Modern Greece is distributed into sixteen *nomoi* or provinces, which are subdivided into fifty-nine *eparchies* or prefectures, and these again are parcelled out into cantons. It is also geographically divided into three parts as follows:—

Northern Greece, or Hellas, bordering upon Turkey, comprehends the territories occupied by the ancient states of Attica, Megaris, Acarnania, Ætolia, Doris, Locris, Phocis, Bœotia, Thessalia, and part of Epirus.

Southern Greece, or the ancient *Peloponnesus*, now called the Morea, contains the states of Achaia, Elis, Messenia, Laconia, Argolis, and Arcadia. Broken by numerous bays and projections, its coast line was deemed difficult and dangerous to the inexperienced navigators of early times.

Insular Greece, or the Archipelago, on the eastern side of the mainland, embraces the island of Eubœa, the group of the Cyclades, and a portion of the Sporades. The Ionian series extends along the south and west coasts. The isles

of the Archipelago have a very varying character. Some are scorched and sterile volcanic masses, while others exhibit the soft yet grand features common to districts which have a rocky skeleton clothed with fertile soil. On some of the islands are ruins of grand temples, erected in honour of long-dethroned gods and goddesses; and many historic and poetic associations cling to the coves and headlands. Eubœa, sometimes called Negropont, is the largest island in the Ægean Sea, and is remarkable for its great length and scanty breadth. At one point, near the centre, it so closely approaches the mainland as to admit of a bridge being thrown across the intervening channel. The pastures of the island are excellent, and the declivities of the mountains are covered with forests of fir. The chief products are cotton, oil, wine, fruit, and honey, and the inhabitants are mostly engaged in the breeding of cattle. The Cyclades, of which there are twenty of some size, form a cluster on the south, and were so called from the legend of their circling around Delos when that island was rendered stationary by the birth of Diana and Apollo. Three of the number are naturally remarkable—Santorin, an active volcanic centre; Paros, yielding the fine white marble of the statuary; and Antiparos, celebrated for its grotto in the limestone rock. The Sporades, or "scattered islands," were so styled from their irregular distribution. Only a few of them now belong to the kingdom of Greece.

The Ionian Islands extend from the south extremity of the Greek peninsula along its western coast to that of Albania. There are seven principal islands—Corfu, Paxo, Santa Maura, Thiaki, Cephalonia, Zante, and Cerigo—and upwards of thirty smaller ones. They belong to the same great calcareous formation which prevails over Greece. They were placed under the protectorate of Great Britain in 1815, and ceded to the Greek kingdom in 1864. See Ionian Islands.

Population, &c.—Greece, at the last census, taken June, 1879, had a total population of 1,679,775—of whom 881,080 were males and 798,695 females—living on an area of 19,941 English square miles. The kingdom is divided into sixteen nomoi or nomarchies. By the return of the census of 1879 the area and population of each were as follows:—

	Area, Eng. Square Miles.	Population in 1879.
Northern Greece—		
Attica and Bœotia, ...	2472	185,364
Phocis and Phthiotis, ...	2044	128,440
Acarnania and Ætolia, ...	3013	138,444
Peloponnesus—		
Argolis and Corinth, ...	1442	136,081
Achaia and Elis, ...	1901	181,632
Arcadia, ...	2020	148,905
Messenia, ...	1221	155,760
Laconia, ...	1679	121,116
Islands—		
Eubœa and Sporades, ...	2216	95,136
Cyclades, ...	923	132,020
Corfu, ...	431	106,109
Zante (Zakynthos), ...	277	41,522
Cephalonia (Kephallonia), . .	302	80,543
Soldiers and Seamen, ...	—	25,703
Thessaly (1882)—		
Arta, ...	5100	31,141
Trikkoula, ...		116,768
Larissa, ...		145,947
Natives abroad, ...	—	5,684
Total, ...	25,041	1,979,305

The Albanian territory, detached from Thessaly and Epirus, was added to Greece by a treaty with Turkey, executed—under pressure of the great powers—14th June, 1881. The total population in 1884 was probably 2,000,000.

At the liberation of the country there were only nine towns which had partly escaped the total devastation of the rest; the principal of them being Lamia, Vonitza, Nauplia, and Chalcis. All the other towns and villages were in ruins, so that the first necessity of the inhabitants of the new state was to get housed. Since that time ten new cities have been founded, and twenty-three old towns, including Athens, Thebes, and Argos, have been rebuilt, besides many villages.

From a linguistic point of view, at least, the nationality of Greece is mainly Hellenic. Most of the Albanians who have at various dates during the last 400 years migrated into Greece, have become Hellenized. At present there are not more than 90,000 or 100,000 of distinct Albanian nationality in the whole of Greece. These are scattered in small communities chiefly over Attica; northwards, as far as Thebes; then across the isthmus of Corinth, throughout the ancient Argolis; in the southern districts of Eubœa, and a few of the neighbouring isles. On the other hand, there are large numbers of Greeks in the Ottoman Empire, raising the whole Greek nationality to nearly 8,000,000, as under: Greece, about 2,000,000; Asia Minor, 2,000,000; Crete, Cyprus, and other Ottoman islands, 400,000; European Turkey, 3,500,000; total, 7,900,000.

The Greeks style themselves Hellenes, and are proud of their ancestry; and the Mainotes, who occupy the mountain ranges of the Morea, boast of being true sons of the ancient Spartans. In insular Greece the manners and customs of antiquity remain; domestic habits have undergone little change among the peasantry; agricultural implements are much the same, and salted olives, coarse bread, and common vegetables are now, as they were then, the ordinary food. The inhabitants of the coast towns and the islands are actively commercial and produce expert seamen. In the inland districts agricultural and pastoral pursuits are followed, but the mountaineers are averse to industrial pursuits and apt to be predatory. In general, the Greeks are a race of quick perceptions, in gesture vivacious, intensely voluble, and very temperate both in eating and drinking.

Language and Literature.—Modern Greek, sometimes called *Romaic*, is not a derivative from classical Greek; it is the very tongue itself, not very greatly modified by time. See Greek Language and Literature.

History of Modern Greece, and Present Condition of the Country.—After the capture of Corinth, 146 B.C., Greece became a province of the Roman Empire, and continued as such for several centuries—the different Roman wars often involving it in great hardships and entailing upon it many calamities. But for nearly two centuries after the accession of Augustus the country enjoyed comparative tranquillity, during which Christianity spread among the people; many churches were built, and a large number of Greeks became missionaries to propagate the gospel in foreign lands. In 1204 the Venetian fleet, under Dandolo, completely defeated the Romans, and Greece changed masters. In 1453 the Turks captured Constantinople, and from that time till 1830 the country was under Mohammedan dominion, although attempts were several times made to throw off their galling yoke. Under the Turkish rule the Greeks were often treated with great indignity and hardship, and in 1821 they commenced a war of nine years' duration, which is known as the War of Independence. The battle of Navarino in 1827, in which the combined English, French, and Russian fleets completely annihilated that of the Turks, prepared the way for the independence of Greece, which was proclaimed by the National Assembly at Nauplia, on 3rd February, 1830. The first president, Capo d'Istria, governed for a short time, but was assassinated in 1832. The throne was offered to Leopold, king of the Belgians, but he declined it, and it was then accepted by Otho, second son of the King

of Bavaria. The selection was chiefly due to the three powers—England, France, and Russia—who had assisted Greece in her struggle, and who agreed to use their powerful influence in his behalf. Otho did not attain his majority till 1835, when he assumed the reins of government. For some years German influence was allowed to prevail to too great an extent, and there was so much dissatisfaction among the people that the king was obliged to grant a liberal constitution in 1844. But though the Bavarian ministers were dismissed, the king and his Greek advisers showed the most reactionary tendencies, and attempted in various ways to curtail the privileges of the people. The impunity with which brigandage and piracy were practised in Greece, as well as the alliance of the Greek government (against the wish of the king) with that of Russia during the Crimean War, caused the English and French to send a detachment to occupy the town of Piræus. During their stay brigandage and piracy were greatly suppressed, and the king was enabled to check the enthusiasm of his subjects for Russia; but on their removal, in 1857, his position became more and more difficult, as the brigands renewed their acts of violence, and his council was composed of men unable or unwilling to support him. He felt compelled to resort to strong measures, which only increased the popular discontent; and the great influence which the ministers exercised in the elections, as well as the repugnance of the king to claim an extension of territory, were the causes of an insurrection, which was decided in October, 1862, by the departure of Otho for Bavaria. The crown was first offered to Prince Alfred, second son of her Majesty Queen Victoria, and on his refusal, was accepted by the present king, George I., the second son of the King of Denmark, who was born 24th December, 1845. One of the principal conditions on which he accepted the throne was that the Ionian Islands, which had been under the protection of Great Britain, in virtue of the treaty of Paris, since 1815, should be annexed to Greece. The annexation took place in 1864. In 1867 the king married Princess Olga, daughter of the grand-duke of Russia.

Notwithstanding the considerable progress of the Greeks in civilization, learning, and the arts of life within the present generation, the material condition of the country is far from satisfactory. There is a wonderful zeal for learning, and the state rejoices in literary ministers and philosophical deputies like the most advanced of its neighbours; at the same time, there is such an utter absence of a practical direction in the system of national education, that the system itself has become the most effectual obstacle to all social and material improvement. A ruinous system of taxation, which consists of levying in the rudest and most oppressive fashion a tithe or other fixed proportion of the produce, directly discourages all improvements in agriculture; mistaken patriotism enables protection to stop the development of commerce and navigation, and central administrative jealousy prevents the people from acquiring experience in self-government. As for roads, bridges, ferries, steamers, maritime communications with the numerous islands and extensive coasts of the kingdom, quays, landing-places, inns, and post-horses, Greece is behind every other country in Europe. Some slight improvements have recently been made in the construction of roads and railways between some of the most important towns. Until 1882 the only railway was one between Athens and the Piræus, about 6 miles in length. This and carriage roads of about 700 miles in length formed the total means of communication.

Greece has universal suffrage, and civil servants are removable on a change of ministry. This small inducement is held out for able men to accept office. The liberal professions are overstocked, and Greece has too many politicians and too many political journalists. Judging from the results, the purpose of the governmental system would seem to be to provide state support for the greatest possible number of persons. With a total population in the whole country less than half that of London, it takes nearly 19,000 people to carry on the machinery of civil government; or in other words, if their families be reckoned, one-twelfth of the population of the state is thus maintained—exclusive of soldiers, sailors, pensioners, the extra hands and lawyers, &c., about the foreign office. If the result of all this costly administration was an efficient government which cared well for the wants of the people, it might after all not be money entirely wasted; but unfortunately party motives and wretched squabbles often occupy the legislature, to the exclusion of the real good of the country.

And yet, in spite of heavy disadvantages, a comparison of Greece to-day with Greece under Turkish rule, shows a substantial and even remarkable advance in both moral and material prosperity. Under the Turks Athens was for 400 years merely a second-rate provincial town in the pashalic of Eubœa. In 1821 its population was about 10,000. It was then a torpid, poverty-stricken place, while the harbour of the Piræus (Porto Leone) had fallen into utter decay. Athens is now a handsome and prosperous city, with a population of 65,000; the Piræus has a further population of 25,000, and contains some thirty steam factories. The heights surrounding the harbour of Mounychia, then utterly bare and valueless, are now occupied by beautiful villas, and have become valuable property. The public buildings are admired by all foreign visitors for their grace and purity of taste. In excuse for the backwardness of the road system, it is said that the rocky hills and frequent ravines of Greece render road-making enormously costly; but the exigencies of the currant trade and the silk trade are tending to supply both the motive and the means for making roads which shall more thoroughly open up the Morea. The system of small holdings which prevails is a serious obstacle to scientific methods of farming, but agriculture in Greece has made creditable progress within the last few years. It is the growth of the towns especially that, by providing a steady market for products, has given that stimulus to agriculture which nothing else could supply, and already there are seen a marked rise in the value of farms within easy distance of the cities, and plain signs of better attention to agricultural pursuits. It is necessary, however, that more capital should be invested in land, and the system of small holdings modified, before Greek agriculture can become what it might and should be—the foundation and mainstay of Greek prosperity. All observers testify to the good moral character of the rural population in Greece. They work hard and live hardly. Drunkenness is almost unknown, and insanity is very rare.

So utter was the prostration and impoverishment of the country at the time its independence was achieved, that the task then before Greece was like that of a people set to make bricks without straw; and judging the country by its general position and prosperity, as compared with the state of things from which it started, the progress of Greece must be considered as creditable. It cannot be said that either Turkey or Russia represents those blessings which British subjects, under the British monarchy, have learned to associate with constitutional freedom, and which they believe to be inseparable from the highest and most beneficent form of civilization. The Greeks, on the other hand, have won constitutional freedom by patient effort, and have proved that they can use it; and it is generally admitted that it was a mistake to make the Greek kingdom so small, and to give it such a frontier. During the Russo-Turkish war of 1877–78 the Greeks were with difficulty restrained from striking in vigorously at their old oppressors. The chief thing, doubtless, which kept them back was a promise that their claims should be considered when the general settlement came. The treaty of Berlin accordingly intimated that some considerable

enlargements of territory should be conceded to Greece, and in 1881 Turkey, under much pressure from the great European powers, yielded up a large portion of Albania.

Constitution and Government.—The constitution of King Otho in 1844 guaranteed to the citizens equality in the eye of the law, civil and religious liberty, freedom of the press, and education at the public expense; and also threw open offices of state and places of distinction to all. The king's person was sacred. In 1861 a new constitution was established on the basis of universal suffrage, and it was decided that the whole legislative power should be vested in a single Chamber of Deputies.

The executive is divided into eight departments, namely, the presidency of the council, the ministries of the interior, of finance, of justice, of education and public worship, of war, of foreign affairs, and of marine. A president of the council superintends the deliberations of the ministry as chief functionary of the government.

Revenue and Expenditure.—The finances of the kingdom are at present in a most disordered state, and nowhere, perhaps, are the accounts of the treasury falsified more systematically or unblushingly than in Greece. The annual balance-sheet was formerly always struck so as to show an equilibrium or a surplus, and yet since its establishment as an independent kingdom there have been few years without a deficit. The revenue varies from £1,500,000 to £2,000,000 per annum. The public debt amounted in 1884 to £18,000,000. Two loans of £2,000,000 each—one issued at 59 and the other at 56½—were taken in London in 1824 and 1825, but no interest was paid on either from 1826 to 1878. In the latter year an agreement was signed between the government and the bondholders, under which the latter consented to receive new bonds of the value of £31 12*s.* and £30 10*s.*, bearing 5 per cent. interest per annum, with a sinking fund attached. By the terms of the agreement the Greek government has to set aside £60,000 annually for interest, and £15,000 for the redemption of the new bonds. A loan of £2,350,000 was contracted in 1862 upon the elevation of King George to the throne. Upon this loan the dividends have been regularly paid, but only from reserved funds of the loan itself in the first instance, and since then from the treasuries of the guaranteeing powers—England, France, and Russia.

Army and Navy.—The army, till recently, was raised by conscription, but in 1879 a law was passed introducing universal liability to arms, after the model of Germany. The law, which came into operation in 1880, provides that all able-bodied males aged twenty-one and upwards shall be compelled to serve, and that no substitute shall be allowed. The nominal strength of the army is 24,000 men. The navy consists of fourteen vessels. It is manned principally by conscription from the inhabitants on the coast, but volunteering is greatly encouraged by the government.

Religion and Education.—The ecclesiastical government of the Greek Church is nominally subject to the Patriarch of Constantinople, but the real authority is exercised by four archbishops and bishops, who meet in annual synod, presided over by the metropolitan of Athens. The church possesses vast property in many parts of the kingdom, particularly in the Morea. There is universal toleration for all creeds, but more than nine-tenths of the population belong to the established church, which acknowledges the king as its temporal head. See Greek Church.

Within the last generation education has made great progress; and as every kind of instruction—from that given in the humblest school to the university—is free to all, an unusual number of Greeks press into the learned professions, and a large educational machinery is required to supply the demand for knowledge. There are about 400 communal or elementary schools, and 200 Hellenic schools, in which latter ancient Greek, Latin, mathematics, &c., are taught. There are also a military school, a polytechnic for trades and professions, a training school for schoolmasters and schoolmistresses, an agricultural school, and a university at Athens, which has four faculties—theology, philosophy, law, and medicine. All the educational institutions are well attended; but the universally gratuitous system of education has its drawback in the fact that thousands of men who, under other circumstances, would take their places in the ranks of productive industry, think themselves fitted for some more intellectual calling. Every deputy in the representative chamber is besieged by a host of applicants for even the least remunerative public posts, while the manual labour market has to be largely supplied from Crete and elsewhere. There is a most painful dearth of practical men in surveying, farming, road-making, and bridge-building, but a plethora of lawyers, writers, clerks, &c., who in the absence of regular occupation become agitators and coffee-house politicians.

Manufactures, Trade, and Commerce.—The manufactures are few and unimportant. Cotton and woollen stuffs, and some minor articles, are made by the peasants for domestic use. Shipbuilding is carried on at most of the seaports; and silks, gauze stuffs, cutlery, hardware, earthenware, leather, saddlery, &c., are made in small quantities in some of the principal towns and islands. The Greeks display great skill in embroidering in silk, gold, and silver, also in cutting marble and sculpture; and the modern inhabitants are not behind their ancestors in the art of dyeing in bright colours. Most of the skilled artisans are, however, imported from abroad.

The extensive line of coast, and the numerous islands, supply Greece with a multitude of good sailors. The commerce and navigation of the country are chiefly centred in the ports of Athens (the Piræus), Patras, Nauplia, Syra, Kalamata, Navarino, Missolonghi, and Vostizza. The exports to and imports from foreign countries amount together to rather more than £6,500,000 per annum, the imports amounting to about £4,000,000 and the exports to £2,500,000. The latter consist chiefly of currants, lead, oil, tobacco, valonia, figs, sponge, emery, &c., and latterly a new and important trade was opened out through the demand for Peloponnesian currants in Marseilles, where they are now largely used in the manufacture of wines. The imports are chiefly cotton goods, hides, woollens, iron, coffee, coal, gunpowder, copper, sugar, &c. The principal trade is with England. The total value of the exports from Greece to the United Kingdom in 1883 was £1,937,724; of the imports of British and Irish produce, £1,294,695. The Greeks have adopted the decimal coinage of France, Italy, &c. The Greek *drachma*, formerly worth 8½*d.* only, is now the exact equivalent of the French franc, and one passes current for the other if need be.

GREEK ARCHITECTURE. In the article Architecture it was said that, like all the rest of our fine arts, our architecture comes to us from the Greeks; partly directly as the classic architecture, and partly modified and changed in the Gothic Architecture. The latter is elsewhere treated. Here we consider classic architecture in its origin—that is, the pure and noble Greek form. From the Greek the Roman and Italian orders are derived, and, so modified, it prevails more or less throughout the whole of Europe at the present day. It is necessary to explain that what is termed an order consists of two principal divisions, the *column* and the *entablature*—that is, the upright support and the horizontal mass supported by it; the column being again divided into *base*, *shaft*, and *capital* (except in the Doric order, where the shaft rests immediately upon the flooring); the entablature also into three parts—*architrave*, or epistylium, *frieze*, and *cornice*. These together constitute an order, which is further distinguished as belonging either to the Doric, or Ionic, or

the Corinthian style, according to certain general proportions and characteristic embellishments. These terms and others, together with the current theory of the origin of the whole system, are duly treated of and illustrated in the article Architecture and its accompanying Plate. The scale for the proportions—that is, not the actual but the relative dimensions of the different parts compared with each other—is taken from the lower diameter of the shaft of the column, which is divided into two modules or sixty minutes. Modern systematizers have attempted to fix certain invariable proportions for each order; and some have maintained that by them, quite as much as by peculiarities of detail and embellishment, the character of an order is determined. In regard to proportions, however, even greater discrepancy is found between different examples of the same order than between two distinct orders. We must therefore attend to certain indicial features and marks by which the particular order may be immediately recognized: thus the absence of base or mouldings at the bottom of the column, the plain capital—composed of merely an echinus (a large and elegant ovolo) and an abacus—and a triglyphed frieze, enable us to pronounce at once that the order is the Doric. In like manner the voluted capital, or the foliaged one, as distinctly denotes that it is Ionic in the one case and Corinthian in the other. In regard to the two last-mentioned the principal distinction between them is confined to the capital, there being no determinate difference between the shafts of the one or the other, or in the entablatures, if we except the modillions peculiar to the Corinthian. Were we to see only the shaft of the column, we should be able to decide from that alone whether it were Doric or not, the flutings peculiar to that order being broad and shallow, and forming sharp ridges or arrises on the circumference of the shafts; whereas in the other two they are narrower and deeper, rounded at their extremities, and divided from each other by fillets or spaces left between the channels on the surface of the shaft. In like manner were we to see the fragment of an architrave, we could pronounce with tolerable certainty whether it was Doric or not; although in the latter case not quite so clearly whether it was Ionic or Corinthian. The Doric architrave consists of a single plain face surmounted by a broad fillet, here termed the *tænia*, to which another fillet with small *guttæ* or drops is attached beneath each triglyph; but the architraves of the other two orders are divided into (generally) three faces slightly projecting one above the other, and crowned by curved mouldings, which are sometimes plain, but more frequently enriched. The frieze is not cut up by triglyphs like the Doric, but extends in an unbroken surface, often bearing a long bas-relief. By attending to these few simple and obvious distinctions no one can feel any difficulty in ascertaining the particular order to which a building belongs. The earliest examples of the Doric—as, for instance, that of the temple at Corinth—are marked by a massiveness of proportions approaching to heaviness, if not to rudeness. So also the early Doric (Greek) temple at Pæstum in Italy.

In attentively examining the Doric, specimens of which are engraved in Plates I. and II. and in Plate ARCHITECTURE (Temple of Theseus), we can hardly fail to note what admirable taste and study of effect it exhibits throughout, and how every part is made to conduce to the character of the whole. The columns are of short proportions, the entablature deep; the columns have no bases, which, owing to the narrowness of the intercolumns, would have proved highly inconvenient. The fluting, while it diminishes the heaviness, produces great variety of light and shade in every direction; and the mode of fluting peculiar to this order is admirably in unison with the expression of all the rest, the channels being wide and shallow, and separated from each other by mere ridges on the surface; both of which circumstances contribute to that breadth and simplicity which pervade the other parts. No less appropriate and well imagined is the capital, which consists of little more than an echinus and deep square abacus above it, the former expanding itself out from the neck, or upper part of the column, until its diameter becomes equal to that of the foot of the column; in reality it is something greater, but not more so than is requisite to counteract the apparent diminution caused by the greater distance from the eye. The architrave is plain and deep, well proportioned both as to the weight which it has to bear and to the column below, its average height being equal to the upper diameter or narrowest part of the column. The width of its *soffit*, or under side, is about a medium between the two extreme diameters, so that it overhangs the upper part of the shaft; yet it is not so broad as the abacus of the capital, which by opposing a greater surface to it appears better calculated to support its pressure. In the Grecian Doric the frieze is generally of the same dimensions as the architrave, very rarely deeper, in some examples not so deep. The metopes or spaces between the triglyphs (which were originally intended to represent the extremities of the beams resting upon the architrave and forming the inner roof or ceiling) are square, or nearly so. They are, in fact, so many small panels, and were generally filled with sculpture in bas-relief. Beneath each triglyph is a series of small guttæ attached to a fillet, just under the moulding of the architrave, to which division of the entablature they may be said to belong although evidently

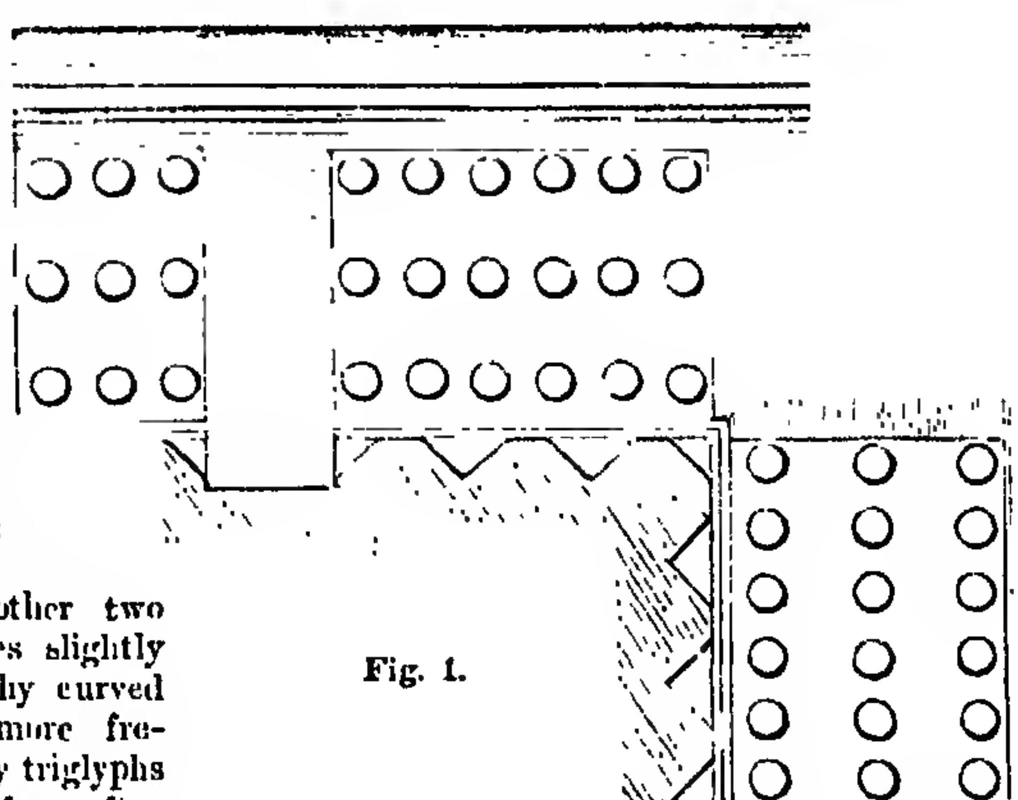


Fig. 1.

Mutules of the Doric Order, seen from beneath.

a continuation of the ornaments on the frieze, they contribute to architectonic expression and effect, inasmuch as they break the monotony of line, and, by extending some ornament to the architrave, bring it into harmony with the frieze. The space between one triglyph and another being regulated by the height of the frieze, since each metope forms a square, this circumstance also regulates the *intercolumniation*, or distances at which the columns are placed.

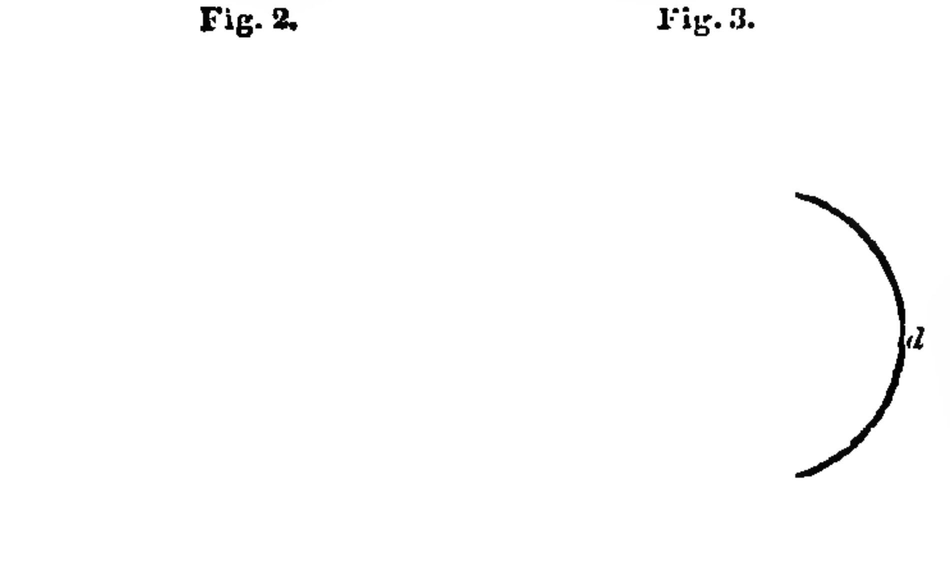
Like every other part of the order, the Grecian Doric cornice is composed of few and bold parts; it consists of little more than a corona (the projecting and principal member in every cornice), finished above by one or two simple mouldings, and having attached to its soffit a series of shallow plates or tablets studded with guttæ. These are termed *mutules*, and are the peculiar distinctive marks of the Doric cornice, in like manner as *dentils* are of the Ionic and *modillions* of the Corinthian. All this is shown in the annexed figure (fig. 1) of the cornice viewed from

below a horizontal section being taken through the frieze. It exhibits the section of the triglyphs, as well as the arrangement of the mutules in the cornice, with their drops.

The sloping or *raking* cornices of the pediment resemble the horizontal one, except that there the mutules are omitted (Roman or Italian Doric retains the mutules). In order, however, to give increased depth and importance to the pediment, as the finish of the whole structure, its cornices have an additional member, termed by some the *epitithedas*, consisting of an ovolo or convex moulding, or a cyma; sometimes deeper, sometimes shallower. This epitithedas was continued a little way at the angles, where it usually terminated against a block, carved with a lion's head or some other ornament. The face of the pediment itself, termed the *tympanum*, was almost always filled with sculpture.

As the mouldings have been alluded to a brief sketch of them is now necessary. And, in the first place, mouldings may be defined to be prismatic or annular solids, formed by plane and curved surfaces, which are employed as ornaments, and are considered as forming constituent parts of an order. If we conceive a straight moulding to be cut through at right angles to its length, the section thus

Fig. 2. Fig. 3.



Doric Fillet. Torus.

formed is termed its profile, and exhibits exactly its characteristic outline, from which its name is derived. Annular mouldings, again, or such as are formed upon a round surface, as the surface of a column, must be cut by a plane passing through the centre line or axis of the column, in order to exhibit their characteristic sections or profiles.

A prevailing gracefulness of outline characterizes the mouldings of the Grecian order, which at once distinguishes them from the more unpretending and simpler mouldings of the Roman. The Roman mouldings are usually composed of circular arcs. The far more beautiful Grecian mouldings exhibit every variety of conic section, elliptical, parabolical, and hyperbolical, the circle being only employed in small cavettos and mouldings of contrary flexure.

The regular mouldings are eight in number, and are thus named:—The Fillet or Band, the Torus, the Astragal or Bead, the Ovolo, the Cavetto, the Cyma recta, the Cyma reversa or Talon, and the Scotia. In the following descriptions the extreme points of the curves are always assumed to be given.

The Fillet, *a*, fig. 2, is the smallest rectangular member in any composition of mouldings. When it stands upon a flat surface its projection from the surface is generally made equal to its height. In general it is employed to separate other members, as the architrave from the frieze in Doric.

The Torus and Astragal, shaped like ropes, which perhaps indicate their origin, are intended to bind and strengthen the parts to which they are applied. In form the torus is a semicircle which projects from a vertical diameter. Thus, in fig. 3, let *a b* be the vertical diameter, from which the torus projects; bisect *a b* at the point *c*; from *c* as a centre describe the semicircle *a d b*; this will be the profile of the torus, which, it will be noticed, is surmounted by a fillet, *b e*. The astragal is described in the same way as the torus, the only distinction between them being that, when employed in the same order, the astragal is smaller than the torus. The torus is generally employed in the bases of columns; the astragal, both in bases and capitals.

The Ovolo is a member strong at the extremity, and obviously intended for support; it is usually employed above the eye as a supporter to the essential members of the composition. The Roman ovolo consists of a quadrant or a less portion of a circle, and is described as in the cuts,

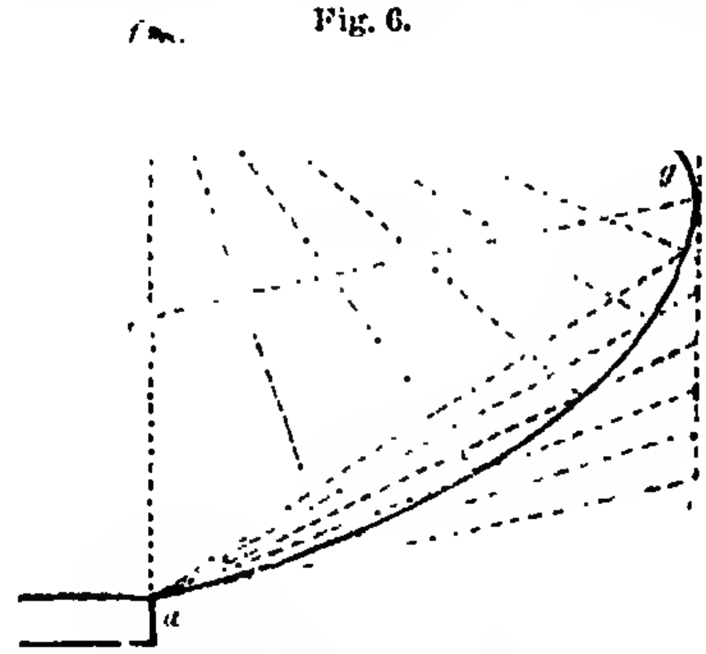
Fig. 4. Fig. 5.

Roman Ovolo.

the height and projection being given. In fig. 4, *b* is the centre, *b c* being equal to *b a*; in fig. 5, *d* is the centre, *d c* being equal to *d a*.

The beautiful elliptic Greek ovolo, unlike the Roman ovolo, cannot be described by means of circular arcs; it must be described by finding a number of points in it. For this purpose draw the tangent *a c* from the lower extremity, *a* indicating the inclination of the curve at that point; draw also the vertical line *d b c* through the extreme point, *b*, or projection of the curve. Draw *b e* parallel to *c a*, and *a e f* parallel to *c b*; make *e f* equal to *a e*; divide the lines *e b* and *b c* into the same convenient number of equal parts; draw straight lines from the point *a* to the points of division in *b c*, and similarly draw straight lines from the point *f*, through the points of division in *b e*, meeting successively the lines drawn from *a* to *b c*; the points of intersection of the pairs of lines thus drawn will be as many points in the contour of the moulding, and a

Fig. 6.



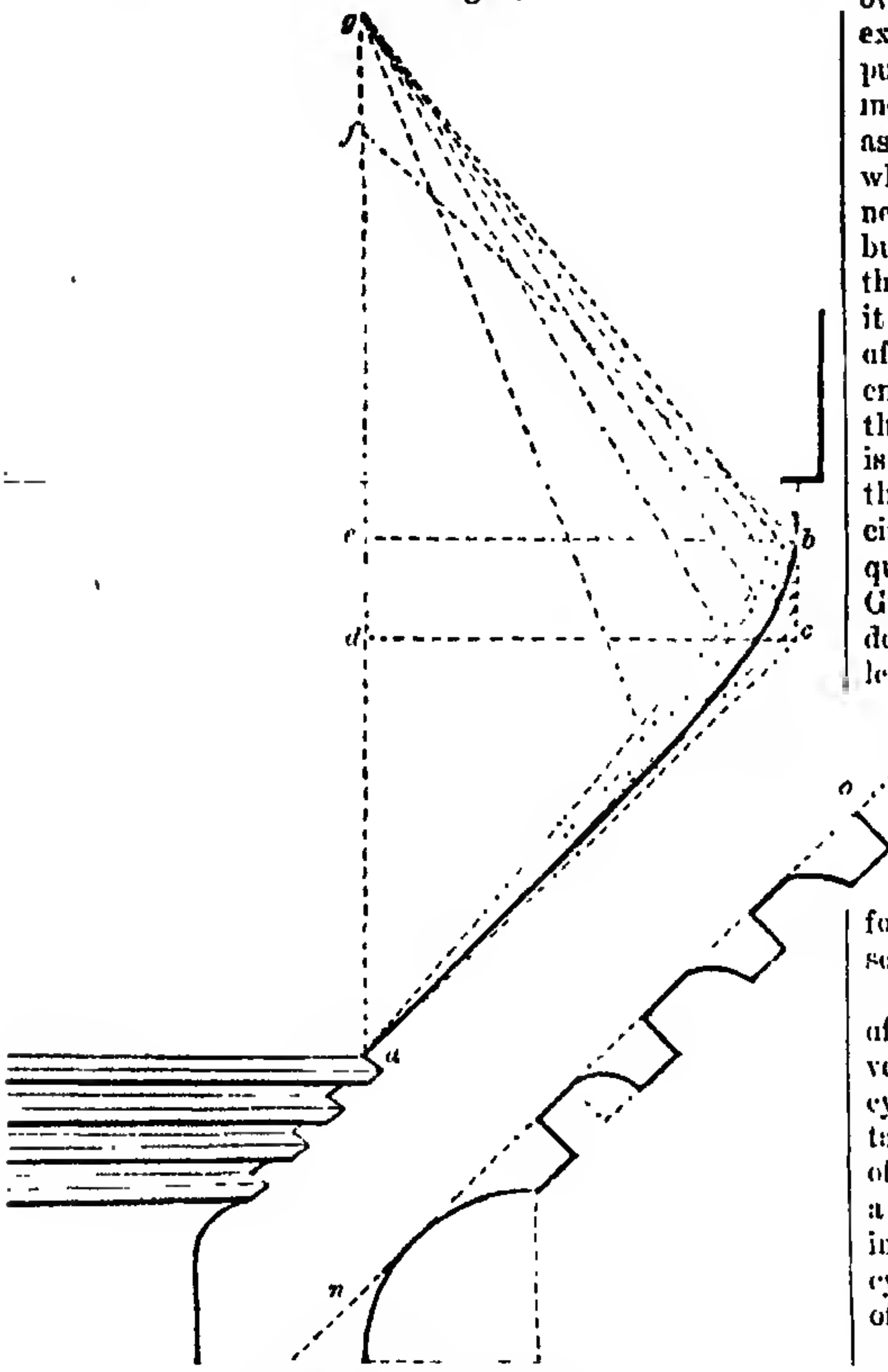
Greek Ovolo (Elliptic).

curve traced so as to embrace these points will be the greater part of the contour. The curve drawn in this manner is a portion of an ellipse, somewhat greater than a fourth of the whole circumference. The recess of the moulding, *h g d*, at its projecting point is denominated a *quirk*. Fig. 5 is, from its great projection relatively to its height, adapted for capitals of Doric columns. With less projection it would be suitable for entablatures.

To describe the hyperbolic ovolo (fig. 7), as employed in Doric capitals—Having given the projection *b* of the curve

and the lower extremity *a*, draw the line *a c*, a tangent to the lower end of the curve, and *b c* vertically through the point *b*; draw *a g* vertically from *a*, and *b e* and *c d* perpen-

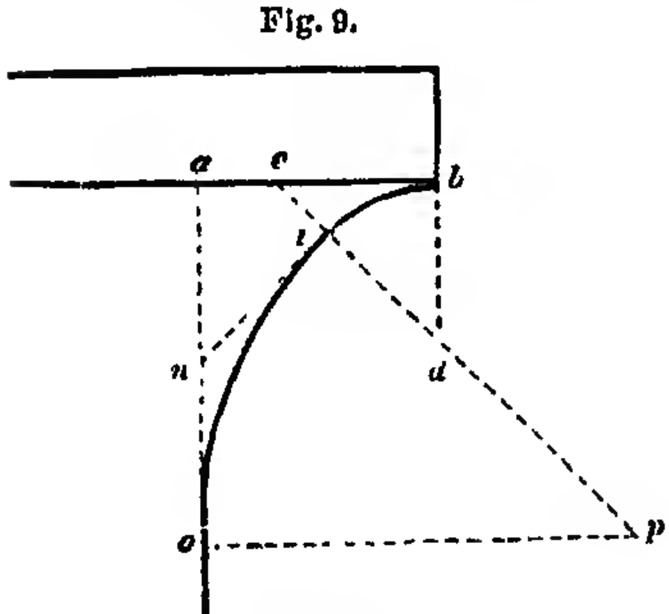
Fig. 7.



Greek Ovolo (Hyperbolic).

dicular to *a g*; set off *e f* equal to *a d*, and *e g* equal to *a c*; join *b f*, and divide *b f* and *b c* into the same convenient number of equal parts; draw straight lines from *a* to the points of division in *b c*, and also straight lines from *g* through the points in *f b*; the successive intersections of these lines, as in the foregoing case, are the positions of as

Fig. 9.



Greek Cavetto.

many points in the contour. This is the general form of the ovolos in the capitals of the Grecian Doric. It will be seen that the lower part towards *a* is nearly straight, and is succeeded by four fillets, shown in section on a large scale, and rounded away on the under sides into the fundamental line *n o*.

The Cavetto (figs. 8 and 9), which is the reverse of the ovolo, both in regard to form and to the weakness of the extreme parts, is well adapted for purposes of shelter for the other members. It is always employed as a finishing, and is here applied where strength is required. It is never used in bases or capitals, but frequently in entablatures; thus in the Roman Doric order it forms the crowning member of the cornice, and is evidently employed to overhang and shield the under members. The cavetto is described in the same way as the Roman ovolo — by arcs of circles, which may be either full quadrants or of less extent. The Greek cavetto (fig. 9) is somewhat elliptical, and may be described by a combination of two circular arcs; thus, let *a b* be the projection of the moulding, and *a c* the vertical line; from the point *a* draw *b d* vertically from *b*, and make it equal to *b e*, which is two-thirds of *b a*; from the centre *d* describe the arc *b i*; draw *i n* perpendicular to *e d*, make *n o* equal to *n i*, draw *o p* perpendicular to *a c*, and meeting *e d* produced in *p*, and from the centre *p* thus found describe the arc *i o*. The contour *b i o c* will represent the Greek cavetto.

Fig. 8.

Roman Cavetto.

The Cyma or Ogee is the term applied to a moulding of which the section is compounded of a concave and convex surface. There are two species of cymatium: the cyma recta (or simply the cyma) and the cyma reversa or talon. The Roman cymatium or cyma is usually composed of circular arcs, which may be either equal to or less than a fourth of a circumference. Thus, in the accompanying figures, 10 and 11, the former of which represents the cyma recta and the latter the talon, *a c* and *c b* are arcs of circles.

The Greek cyma recta differs little from the Roman, except in that its projection over the under fillet is less than that of the latter, and that its curvature is also less. It may be described similarly to the Roman cyma (fig. 10) by means of circular arcs, described with radii of greater length. The nature of the Greek cyma reversa or talon is represented in fig. 12; the curvature of the moulding is much more deeply marked than that of the Roman talon. The concave portion *a c* is deeply indented, and the convex portion *b n c* projects considerably, and is *quirked* or turned inwards at *b*. The following is a simple mode of constructing the moulding: join the points *a b*, the

Fig. 10.

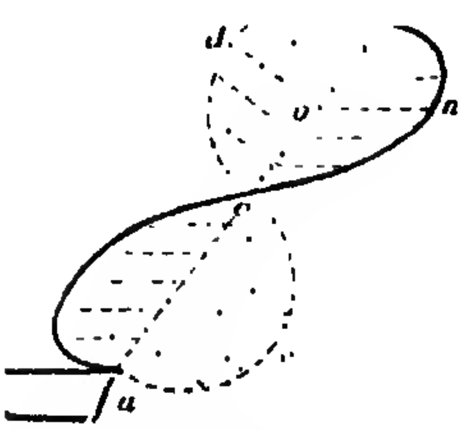
Roman Cyma recta.

Fig. 11.

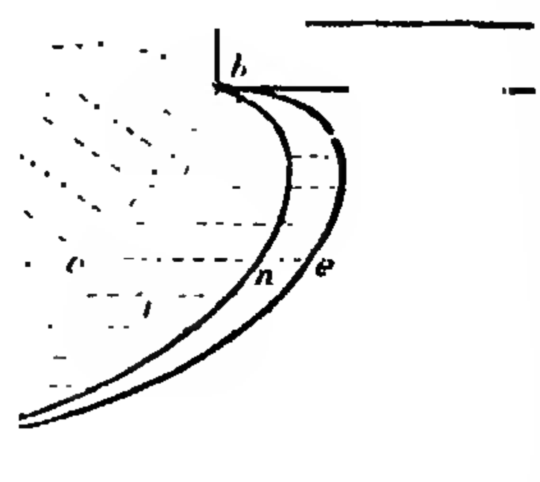
Roman Talon.

extremities of the curve; bisect $a\ b$ at the point c; upon $b\ c$, as a diameter, describe the semicircle $c\ d\ b$, and from $a\ c$ describe the semicircle $a\ e\ c$; draw perpendiculars $d\ o$ and e, from any number of points in $b\ c$ and $c\ a$, meeting the circumferences of the semicircles; from the same points draw a series of horizontal lines, as represented in the figure, equal in length to the corresponding perpendiculars, $o\ n$ equal to $o\ d$, for example. The curve line, $b\ n\ c\ a$, traced through the extremities of the lines, will be the contour of the moulding. The curve might be rendered flatter by using arcs of circles of a diameter greater than $a\ c$ or $c\ b$. The cyma, like the cavetto, is never applied when strength is required, as it is weak in the extreme parts, though it is applicable as a means of shelter to crowning members. The talon, on the contrary, strong towards its extremity, is, like the ovolo, well adapted for supporting weight.

The Scotia, fig. 13, like the fillet, is employed in bases to separate, contrast, and increase the effect of other mouldings, and conveys a graceful turn to the profile. To describe the scotia, the extremities a and b of the moulding being given: join $a\ b$, describe upon it the semicircle $a\ d\ b$; from the centre c draw a series of lines perpendicularly from $a\ b$, meeting the circumference $a\ d\ b$; draw



Greek Talon.



Greek Scotia.

also a series of horizontal lines from the same points in $a\ b$, as shown in the figure, making these lines equal to the corresponding lines in the semicircle, $c\ e$ equal to $c\ d$, for example; the extremities of these lines will be as many points in the curve. If the recess of the curve is required to be less than $e\ c$, as, for instance, $c\ n$, then set off $c\ o$ equal to $c\ n$, and describe an arc $a\ o\ b$ from the centre i, which will be found after one or two trials; performing the same operation as in the other case, we find the contour $a\ n\ b$. Other modes of describing scotias also exist.

The proportions of the different members of the Doric order, as practised by the Greeks, range within considerably wide limits. The following are the average proportions for the members of the order. Taking the diameter at the bottom of the shaft as the standard of measurement, the column is six diameters in height. The diameter at the upper end of the shaft is three-fourths of a diameter; that is, the shaft diminishes one-fourth of the diameter. The height of the capital is half a diameter; that of the echinus or ovolo, including the annulets, and that of the abacus, are each one quarter of the upper diameter, the annulets together being one-fifth of one of the parts. The horizontal dimension of the abacus is six times its height. The height of the entablature is one-third of that of the column, or two diameters. The height of the cornice being divided into five equal parts, the lowest is given to the fillet, the mutule, and the drops; the next two to the corona, and the remaining two parts are subdivided and disposed of, as shown in the figure, Plate I. The number of annulets in the capital vary from three to five; and the number of horizontal grooves separating the shaft from the capital vary from one to three.

In the Ionic order, specimens of which are shown on Plates I., III., & IV., the column differs widely from that of the Doric, not only in the form of its capital and in having a base, but in the contour of its shaft and the mode of fluting, it being more slender and not tapering so suddenly. The base is generally that termed the Attic base, composed of two tori or convex rings, with a concave moulding, the *scotia*, between them; for as the Doric character demands plane surfaces and lines, so does the Ionic require curved mouldings and contours, as harmonizing with the curved forms of the volutes of the capitals. To prevent the harshness which would result if the mouldings forming the base jutted out abruptly from the lower end of the shaft, the latter is made to spread itself out immediately above the base in a sweeping curve, as in Plate II. (Temple of Athenê Polias), termed the *apophyge*. The number of the flutings of the shaft is increased from twenty to twenty-four, besides which there are spaces left between them (fillets); for the mere arrises or sharp edges peculiar to the Doric or earliest mode of fluting would be utterly at variance with the rounded contours of the base and capital.

The capital may be described generally as consisting of two faces, about as wide, measured across the volutes, as the base—that is, a diameter and a half, which breadth is divided into three equal parts, one being allowed for each volute. These volutes are composed of spiral mouldings, which make several revolutions, and gradually become narrower as they approach what is termed the eye or *cathetus*. These volutes have many fanciful theories to be propounded as to their origin. They have been compared to the curls of women's hair brushed aside from the face, to the bark of certain trees drying and curling in the sun, to certain sea-shells, &c. Immediately beneath this part of the capital is a carved convex moulding, to which succeeds the echinus or ovolo (so called because invariably cut into the form of eggs) and lesser mouldings. The idea of an Ionic capital therefore seems to have been that of introducing an ornamental mass between the echinus and abacus of the earlier shaped capital, and rolling up its deep projecting extremities into volutes. The spiral construction is shown in Plate III., fig. 7. The architrave is divided into three nearly equal faces, projecting very slightly one over the other, and crowned by a *cyma recta* moulding, carved or plain, as the rest happens to be more or less enriched. There being no particular members appropriated to the frieze, as in the Doric order, unless enriched with sculpture, it is a mere plain surface; but although generally so decorated, and usually in bas-relief by the Greeks, there is hardly an instance of it among ourselves in modern imitative work.

The cornice in Athenian examples is exceedingly simple, consisting only of two mouldings beneath the corona, the uppermost being within the hollowed soffit of that member; nor do dentils, which are generally reckoned the distinguishing marks of the Ionic cornice, appear to have been used, except by the Asiatic Greeks. The best way of explaining dentils is to consider them collectively to form a plain square band or fillet into which a series of cuts has been made, dividing it into separate blocks or teeth. Consequently, unless the frieze is enriched with sculpture, so as along with the cornice to produce a rich ornamental mass above the architrave, not only is the cornice apt to appear meagre, but the whole entablature to look cold and naked, even plainer than that of the Doric order, and to offer anything but a pleasing contrast to the elegant richness of the capitals below it. What has already been said in regard to the pediment will suffice for this order likewise, there being no

other difference than what is occasioned by the cornices themselves.

The following may be noted as the general proportions of the Ionic order. The column is eight and a half diameters in height; the diameter of the upper end of the shaft is five-sixths of a diameter; the taper of the shaft is one-sixth. The height of the base, including the plinth, is half a diameter, the heights of the tori and the scotia are nearly equal; the upper fillet of the scotia projects as much as the upper torus. The projection of the lower torus beyond the lower radius of the shaft is one-fifth of a diameter. The height of the capital is half a diameter, the height of the volute is seven-twelfths of a diameter; dividing the height of the volute into three equal parts, the top of the lower one reaches to the bottom of the ovolo, and the second division to the top of the festoon, on the axis of the column. The curvature of the outer spirals springs immediately from the ovolo with which the volute is crowned.

Dividing the whole height of the order into twenty-one parts, four of these go to the entablature, which is therefore two diameters in height; the height is equally distributed between the architrave, the frieze, and the cornice; dividing the height of the architrave into four parts, one part is due to the mouldings of the upper portion or capital; subdividing the capital into nine equal parts, give one to the upper fillet, three to the cavetto, four to the ovolo, and one to the bead. Divide the height of the frieze into six equal parts, and give the upper part to the talon, which forms the capital. Divide the cornice into three equal parts; subdivide the upper and lower thirds, each into six parts; in the upper third, give one part to the upper fillet, four to the cyma recta, and one to the lower fillet, and turn one down into the middle third, for the ovolo under; dispose of the parts in the lower third as appears by the scale.

The projection of the cornice over the cymatium of the frieze is equal to its height. The Greeks never employed antæ or pilasters, except at an angle or the extremity of a wall; and instead of aiming at perfect similarity, they purposely gave to such pilasters bases and antæ-caps dissimilar from those of the columns; neither did they diminish them, but made them of the same width above and below, which width was determined by that of the soffit of the architrave, and was therefore something less than the lower diameter of the column, but greater than the upper diameter, since both in the Doric and the Ionic the architrave overhangs the upper part of the column. Modern architects, if they use antæ or pilasters, generally imitate the proportions of the column.

In regard to ***intercolumniation***, or the distances at which columns are placed from each other, and upon which so much of their effect depends, it has already been mentioned that in the Doric order this is regulated by the triglyphs, and monotriglyphic intercolumniation may be considered as the extreme of pycnostyle (thickly set style), as it will sometimes occasion the columns to be less than a diameter and a half apart. The second mode is termed ***systyle***, or two diameters apart; the third *eustyle*, or two and a quarter. But the precise spaces thus laid down do not seem to have been adhered to; and the Greeks, who seem never to have worked according to rigid fixed rules, although precise rules have been since laid down from their works, seem to have allowed themselves any intermediate interval according to the taste of the architect.

Simple as are the plans of Grecian temples, there are many terms required to express their varieties in regard to the application of columns, besides those denoting the number of columns in front—that is, beneath the pediment. Thus, if there were columns only in front, the building was termed ***prostyle;*** if at each end, *amphiprostyle;* if there were also *colonnades* along the sides, it was said to be *peripteral*, that is, with wings (aisles) or colonnades quite round it. When there were two rows of columns, one behind the other, it was termed *dipteral*. Again, where a range of columns was placed between antæ, forming the extremities of walls at right angles with such colonnade, and produced beyond the proper front to the level of the columns, it was said to be ***in antis***. According to the number of columns in front, porticoes are said to be ***tetrastyle***, that is, with four columns; ***hexastyle*** with six; *octastyle*, with eight; *decastyle*, with ten; and ***dodecastyle***, with twelve, the greatest number that can very well be brought beneath a pediment; and even of these two last the examples are exceedingly rare. If instead of columns at the angles there were antæ, then the number of columns alone was reckoned as before, and would denominate what would be equivalent to a portico containing two or more; thus a *distyle in antis*, that is, two columns between two antæ, would be equal to a tetrastyle, as in both there would be three intercolumns; a ***tetrastyle in antis*** would be equal to a hexastyle, and so on.

Although the name Attic would seem to show the contrary, Grecian architecture affords no precedent for what is termed an Attic order—that is, a series of dwarf pilasters crowned by a cornice and occurring above the entablature; and balustrades also are of modern invention. The only thing of the kind in ancient examples, and that of exceedingly rare occurrence, is a low and plain unbroken podium or parapet—that is, without pilasters or other projections—above the cornice of a building. Far from attempting to conceal the roofs of their temples, the Greeks not only made them very conspicuous in the outline of the pediments, but bestowed much decoration on them, ornamenting the ridges and tiles, and placing a series of ***antefixæ***, or enriched front tiles, above the cornice along the sides of the building. Plate III. gives beautiful and correct specimens of Grecian doors and windows, from the Temple of Athenê Polias, forming the western portion of the Temple of Erechtheus, which indeed are almost the sole extant type in Grecian architecture for such apertures. They are surrounded by a moulded architrave, and the jambs incline towards each other, so that the aperture of the window is somewhat narrower at the top than at bottom.

The doorways of Grecian temples were made lofty and spacious, not only for the sake of rendering them important architectural features, but also because the light was admitted into the cella or interior fane, usually of small dimensions compared with the general structure, through the entrance. Almost the only instance of windows in such structures is that above mentioned; and consequently the interior was imperfectly lighted, unless the temple itself was of the kind denominated hypæthral, that is, exposed to the sky, the centre portion being left unroofed, with merely a covered colonnade or portico around it. Like the windows, Grecian doorways were sometimes narrower at top than at bottom, and were embellished conformably to the character of the building.

Though the small structure at Athens, called the Choragic Monument of Lysicrates, furnishes one of the most exquisitely designed examples of the Corinthian or foliaged-capital order that have been preserved to us, it is one of but very few instances of the application of it by the Greeks; others are the capitals of the small columns supposed to be those of the porch of the Tower of the Winds, and which have merely a single row of leaves at bottom (see Plates III. and IV.) Quite recently, in 1884, fine examples, though still on a moderate scale, were discovered at Epidaurus. It is true that some magnificent edifices belonging to this order, such as the Temple of Zeus Olympius at Athens, were erected in Greece; but they belong to a later period, after the order had been extensively employed by the Romans, who, whether its originators or not, brought it to perfection as a distinct style. That the Romans, with whose taste for magnificence this florid

species of capital well accorded, succeeded in establishing a style comprehending many varieties of it, expressive of different degrees of character up to the most luxuriant richness, is evident from the examples they have left, almost every one of which is distinguished by some peculiarity, although they all agree in certain leading points. The average height of the column is ten diameters, yet the capitals and bases being proportionably deeper, the shaft itself is not much more than eight diameters. The capital is composed of two rows of leaves (generally those termed acanthus), those of the upper rows springing up from between the lower ones. There are eight leaves in each row, so arranged that one of the upper ones accords with the centre of each side of the abacus; and from the sides of the centre leaf spring out other leaves, whence emerge the *hélices* or spirals, placed diagonally to support the extremities of the abacus, besides lesser spirals which meet and sometimes intertwine each other above each middle leaf. The abacus itself, which is peculiar to this order, may be described as square in its general plan, but having its sides made somewhat concave, so as to curve out towards the angles, yet not overhang the body of the capital. Thus not only is extent given without heaviness, but a most pleasing contrast is produced between the convex surface of the column and the concave sides of the abacus.

The Corinthian entablature differs little from that of the Ionic, except in the cornice being made richer and deeper, and the number of its members increased, in order to harmonize with the deeper capital of the columns. One of the features peculiar to it is the series of modillions or small brackets supporting the corona, besides which there are frequently dentils also; sometimes again both are omitted, although there is much ornament in other respects. Indeed the examples of this order vary much, not in their cornices alone, but in numerous other particulars.

The Roman Doric and Ionic, of which there are but few examples extant, are both so decidedly inferior to their Grecian originals that they may well be termed depravations of them. They have, however, been adopted by the Italians. It is unfortunate that the Romans, instead of developing their own magnificent round-arched construction, persisted in copying the Greeks, and copying them too often badly. See ROMAN ARCHITECTURE.

The general plan of a Greek temple was simplicity itself. The inner worship, chiefly of the priests, was sufficiently provided for in the probably rather dark oblong cella and treasury; but the outer worship, that of the people, it was the main object of the builder to arrange for. Consequently the temple was raised on a magnificent structure of steps called a stylobate; it stood on a spacious platform at the top of this imposing approach. Its walls, often in themselves bare and windowless (the door itself frequently unimportant, architecturally speaking), were surrounded at a little distance by splendid columns, beneath which shade could be found, or a procession could wind in and out. No arrangement of equal effect for processional worship as seen from without has ever been invented. But it would be a mistake to think that the Greeks, lovers of variety as they were, tied themselves rigidly down to this rectangular construction as we see it in the Pæstum temples or the Parthenon. In their lighter buildings their charming play of fancy comes out. In Plates III. IV. we give details of the beautifully varied Temple of Erechtheus at Athens, to which the shrine of Athenê Polias and the Temple of Pandrosos are attached in a beautifully irregular manner. The Temple of the Winds (as it is sometimes called, from the subject of the bas-reliefs on the frieze), the octagonal tower of Andronicus Cyrrhestes, is also shown in plan on Plate IV. as well as in elevation, and the details of its exquisite columns are given in Plate III. The small choragic monument of Lysicrates, which is as admired as it is familiar, is another illustration which the Plates afford of the ever-various inventions of Greek taste. A specimen of their occasional over-elaboration of details is shown in an anta-capital from Eleusis. The Greek theatres, scooped out of a hillside in a great semicircular sweep, the proscenium or stage stretching across the chord of the arc, were another and very charming form of Greek architecture. The plan of one of them is given in Plate V., and in GREEK DRAMA the consideration of the way in which the ancients performed their plays will be given. The Romans with their greater engineering skill usually had a velarium or awning; the holes for the awning posts may still be seen in the great chord of the arc forming the outer lofty wall of the theatre, in such structures as that at Orange in France, &c. The Greek theatres were always open to the sky.

The architecture of Greek private houses has been largely preserved to us at Pompeii, which, like all that part of Italy, was far more Greek than Roman. (All South Italy was a large Greek colony or assemblage of colonies, and was called indeed *Magna Græcia.*) Next the street an open space was left with either porticoes on each side of it, or if the owner were economical, shops; this was the *thuroreion* (the Roman *vestibule*), and gave entrance to the interior courtyard of the house, which the Romans made into a room and called *atrium*. The Pompeiian houses have this construction. But in the more ancient Greek construction this interior *peristylion* remained as an unroofed court, the family altar to Zeus in its midst, and surrounded by colonnades, beneath which were rooms for domestic purposes, as eating-rooms, bed-rooms, servants' offices, &c. On the opposite side of the peristylion lay the *prostas*, the chief room of a Greek house, open to the whole width of the peristylion. The "hearth," where burnt the sacred fire of Hestia (the Latin Vesta), we might almost call the roofed-in end of the great courtyard. On one side of the prostas lay the *thalamus*, or bedchamber of the master of the house, and on the other the *amphithalamus*, for his daughters. These opened on the farther side, not into the peristylion, and were in a line with the chambers which, as said above, lined the peristylion itself. Beyond the thalamus, prostas, and amphithalamus, which together cut across the house, lay the *gunaikonitis*, or women's rooms, the peculiar domain of the mistress of the house, entered by a door at the back of the prostas. Here she and her maids sat at their wheels or looms, or plied their other necessary work. Perhaps beyond all lay a garden.

Larger houses had an inner court, perhaps as large, perhaps larger than the peristylion, and the chambers of the gunaikonitis lay all round it. Through the door of the prostas one entered in this case into the inner court instead of into the workrooms. Here and there probably a tall room was cut in half by a floor, and access given by a ladder, as we see at Pompeii; but it is fairly correct to say that Greek houses were all on one floor.

In fact one great characteristic of Greek architecture is its *horizontality*. Herein it differs essentially from Gothic architecture, whose essence is *verticality*. The one style gives a calm beauty and solemn grandeur, the other soars aloft in a very passion of fretted pinnacle, lofty shaft, spire, or bell tower, stimulating the upward thought and outlook.

As to the construction at all events of the public buildings the large and accessible quarries of marble supplied the Greeks with a splendid material, and their magnificent attainments in geometry enabled them to lay as true a line or right angle as we ourselves can. But they went further, and counteracted certain well-known optical delusions by certain subtle deviations from exactness of line which astonish us even now. Thus since a tall true cylinder looks hollow, Greek columns swell with a gentle ENTASIS; since a long true horizontal line will seem to sag in the middle, the entablature of the Parthenon and other long buildings is made gently round, &c. In fact the more

we study these grand works of art the more subtle devices do we discover.

One matter is still an unsolved puzzle. How were these buildings lit? The difficulty arises from all the Greek roofs having perished and no detailed description having been yet found. Some few doubtless, like the Pantheon at Rome, by a simple opening in the roof. But where (as in most cases) a very precious statue was preserved there, this cannot have been the method employed, for rain and snow, during the violent storms not unfrequent in Greece, would certainly wet all parts of the cella and beat upon the statue itself—a very serious matter in the case of one made of gold and ivory. That this could have been allowed is extremely improbable, especially as Pausanias (book v., chap. xi.) is careful to describe the various methods by which the ivory was preserved by a careful attention to the exact amount of moisture it required. Thus, at Olympia, the great statue of Zeus by Phidias was rubbed with oil on account of the damp nature of the surrounding soil; while at Athens the similar statue of Athene, in the dry air of the Acropolis, was cleaned with water to keep the ivory in good state. Such refinements as these would surely have been idle had the statues been exposed to the beat of rain. A second objection is the inartistic effect supposed to be produced by the sunlight striking down from above, and the Greeks studied artistic effects above everything. A third is that it leaves unaccounted for the rows of interior columns. The best and fullest consideration of this knotty point is given by the eminent architectural antiquary James Fergusson, who advocates a sort of clerestory theory ("The Parthenon," London, 1883). Whether his theory is accepted or not his treatment of the subject is most valuable, full, accurate, and highly interesting.

Greek architecture naturally falls into three periods. The *first period* (B.C. 600–470) reaches from the age of Solon to the Persian War. The remains are all Doric in style, not very numerous, but all massive and heavy, the columns very thick in proportion to their height, &c. The most numerous are in Sicily, where there are six temples at Solinus, three at Agrigentum, one at Syracuse, and one at Ægesta, the last very perfect. There are three at Pæstum near Naples, the largest one very fine, and better preserved than even the Parthenon itself. There is only one remaining in Greece itself, the temple at Corinth.

The *second period* reaches from the Persian Wars to the accession of Alexander the Great (B.C. 470–338), and is the grand period. The Temple of Theseus at Athens and that of Athene at Ægina show a transition from the earlier massive Doric to the later elegant variety; while the famous Parthenon, destroyed by the Persians and rebuilt under Pericles about 440 B.C., by Iktinus and Kallicrates, superintended by Phidias himself, entirely in the new Doric at its finest development, proves to be the very flower of Greek architecture, the admiration of Athens and the world. The sculptures of Phidias and his pupils enriched it. Its dimensions are 227 feet long by 101 feet broad. It remained almost intact till the Venetians bombarded it in 1687, when, as the Turks used it as a gunpowder store, it blew up. Slightly later is the Propylæa or entrance-porch to the Acropolis of Mnesicles, also built under the rule of Pericles. At Ephesus at this time rose the famous Ionic temple of Artemis, only fragments of which unhappily remain. The Ionic style is found at Athens in the temple on the Ilissos, the temple of Wingless Victory on the Acropolis (which the Turks turned into a bastion, and which was skilfully restored in 1833), and best of all in the elegant group of temples built shortly after the death of Pericles, called the Erechtheion (see Plates).

The *third period* is the period of elaboration and incipient decay. It begins with the Corinthian style, as in the Temple of Athene at Tegea, built by Scopas 350 B.C., the choragic monument of Lysicrates (see Plate), built at Athens 330 B.C., the mausoleum at Halicarnassus, the temple of Apollo at Miletus, &c., but soon degenerates into profuse ornamentation, and loses its original simplicity and grandeur.

GREEK CHURCH. The Greek or Eastern Church is that part of Christendom which separated from the Roman or Western Church in the ninth century. Even previously to that epoch there were several dissensions between the patriarchs of Constantinople and the popes of Rome, who claimed a supremacy over all the churches of Christendom; but the decided breach between the two churches dates from the year 862. The patriarch Photius reproached the Western Church with the wanton addition of the word "Filioque" (and the Son) to the words "I believe in the Holy Ghost, the Lord and Giver of life, who proceedeth from the Father," contained in the Nicene Creed, and which he declared to be an anti-scriptural doctrine. He reproached them also with having introduced several innovations unknown to the primitive Christian church; as, for instance, the celibacy of priests, the Latin practice of denying to priests the power of administering confirmation, and the fastings on Saturdays; but he particularly inveighed against the assumption of the Roman bishops in considering themselves as the head of all Christendom, and treating the Greek patriarchs as subordinate to them. The final separation, however, of the Eastern from the Western Church did not take place until 1054, when the patriarch Michael Cerularius, in addition to the matters alleged by Photius, attacked the Latins for using unleavened bread at the communion, and for the profligacy of their clergy, &c., for which he was excommunicated by Pope Leo IX. The attempts at uniting the two churches, which were made either by the popes, in order to extend their dominion over the East, or by the emperors of Constantinople, who, being pressed by the Mohammedans, sought assistance from the Western powers, generally failed through the pride and interested motives of the leaders of both parties. The last attempt at uniting the two churches was made by the Emperor John VII. Palæologus, who, being driven to extremity by the Turks, came to Italy, and at the Council of Florence in 1438 acknowledged the supremacy of the pope. This union was, however, not accepted either by the Greek clergy or by the people. Since that time some isolated bodies of Greek Christians have joined the Church of Rome, forming what they call the United Greek Church. They are found chiefly in Italy, Austria, and Poland. But every attempt at a general union with the Roman Catholic Church, or even with Protestant communions, has proved a failure.

The orthodox Greek Church, like the Roman Catholic, acknowledges a double foundation of faith—the Bible and tradition, as recognized by the Greek fathers and by the first seven œcumenic councils. [See COUNCIL OF THE CHURCH.] It forbids the patriarch and the synods to introduce any new dogma, but considers a full belief in those already established as indispensable to salvation. It maintains that the Holy Ghost proceeds only from the Father, differing in that point from the Roman Catholic Church, as well as from all Protestant churches. The Greek Church has seven sacraments—baptism, confirmation, holy eucharist, penance, priesthood, marriage, and unction; but in the ceremonies connected with the administration of these sacraments they differ considerably from the Latin rites. They also disagree as to the honour given to the later general councils, the use of both kinds by the laity in the eucharist, the time of observing Easter, the doctrine of purgatory, the mode of making the sign of the cross, the celibacy of the clergy, the practice of divorce, and the use of the Scriptures by the laity. The Greek Church also recognizes the right of every nation to have its own independent church, and to use its own language. While differing from the Church of Rome on all these

points, the Greek Church agrees with it in the doctrine of transubstantiution, in the intercession of the Virgin and saints, in the reverence paid to pictures (but not to images), in priestly absolution, and in the efficacy of the sacraments. It has no creed in the Western sense of the word. The ritual of the Greek Church is very splendid, consisting chiefly of gorgeous ceremonial. Instrumental music is entirely excluded from divine service, but singing is universally in use.

The fasts are much more numerous and strict than those of the Roman Catholics. Besides Wednesday and Friday in every week, they have four great fasts in the year: Lent, or the fast of forty days before Easter; another fast which lasts from Trinity Day to the feast of St. Peter and St. Paul, 29th of June; a third which continues from the 1st to the 15th of August; and a fourth beginning at St. Philip's Day, on the 15th of November, and ending at Christmas. During all this time they abstain, not only from meat, but also from milk, butter, and eggs.

The Greek convents follow the strict rule of St. Basil. The abbot is called Hegumenos, and the abbess Hegumené. The abbots who superintend several convents have the title of Archimandrite, and rank next to bishops. All the high ecclesiastical dignitaries, such as bishops, archbishops, and metropolitans, are chosen from the regular clergy; while the secular can rise only to the rank of Protopapas, which is only one degree higher than that of an ordinary priest.

The Greek Church, under the Turkish dominion, has preserved almost entirely its ancient organization. It is governed by the patriarchs of Constantinople, Alexandria, Antioch, and Jerusalem, of whom the first, as the œcumenic patriarch, presides over the general synods of Constantinople, which are composed of the above-mentioned patriarchs, several metropolitans and bishops, as well as twelve eminent Greek laymen. He exercises a supreme ecclesiastical authority over all the Greeks of the Ottoman empire, and is also acknowledged as the head of their church by the inhabitants of Austria and the Ionian Islands who profess the Greek religion. The other three patriarchs, whose dioceses are filled with Mohammedans, have exceedingly small flocks. Greece is divided into ten bishoprics: Corinth and Argolis, Achaia and Elis, Messenia, Arcadia, Laconia, Acarnania and Ætolia, Phocis and Locris, Bœotia and Attica, Eubœa, and the Cyclades. The governing body of the church in the kingdom of Greece is a supreme ecclesiastical council consisting of five members, usually archbishops or bishops, but priests or monks are eligible, which is independent of the patriarch of Constantinople in the administration of the external affairs of the church, but acknowledges his authority in matters of faith. The Russian Church, which now constitutes the most important branch of the Greek Church, is noticed in the article on RUSSIA.

The Greeks have a place of worship in London, the congregation, numbering about 500, being mostly merchants and their families. There is also a Russo-Greek Church connected with the Russian embassy.

GREEK DRAMA. The tragic drama of Greece arose from the festival in honour of the god Dionysus (Bacchus), when a chorus in his honour was raised, interspersed with solo recitatives narrating some of the god's adventures. This formed the dithyrambic ode. The word *chorus* included dancing as well as singing, the sacred dance being to the ancients as truly religious as the sacred song. In illustration of this fact David dancing before the ark, and many other famous religious dances, occur to the mind. At this day the dancing Dervishes and the Shakers almost divide the religious aspect of the dance between them.

The next step was that of Thespis in the time of Pisistratus. He hit upon the happy expedient of the chief singer, the protagonist, varying his duet with the chorus by taking first one character, then another, and so representing the varying personages in a religious myth. Still retaining its connection with Dionysus, and appearing in its greatest splendour at the Dionysian festivals, the drama received a further development at the hands of Æschylus (Aischulos), whose first play appeared B.C. 499, and who introduced a second actor. Dialogue now became possible between the actors, and one or both actors could converse with the chorus. The chorus also, hitherto a sort of audience, now became actors themselves; as senators, as warriors, as maidens, &c., they attended the principal character, and by their observations now narrated what passed behind the scenes, now elucidated by questions matters of interest in the plot or traits of character in the principal personages. Thus the necessity for soliloquy was nearly always avoided. At the same time δραμα (action) is, if we consider it, a curious name for a species of composition wherein by the rules of it nothing whatever was allowed to be *done* or *acted* on the stage; but wherein everything was presented by narration. All is talk, assuming what is done as passing or having passed elsewhere. The chorus also, at least once, generally several times in the course of the drama, sang suitable hymns or religious songs, of a tone harmonizing with the drama itself, but not altogether dependent on it. The exquisite hymn to Eros in the "Antigone," or the praise of Athens, "Thou comest here to the land, O friend," in "Œdipus at Kolōnos," occur at once to the memory as instances of a religious and of a patriotic chorus. In this way the form of the ancient dithyrambic ode was preserved. And to complete the conservative nature of the chorus, it was always written in the Doric dialect; because Thespis began the drama in Bœotia when Doric was spoken. An English opera with the choruses in broad Scotch would be a not inapt parallel to this remarkable arrangement.

With two actors, each of them able of course to assume various characters, changing their dresses and their masks, a play with many parts could be acted, though only these two actors were on the stage at any given time. The great dramas of the "Persians," the "Suppliants," and the magnificent "Prometheus" were produced by Æschylus under these apparently crippling conditions. Even here the limitation was so awkward that a lay-figure of Prometheus had in one scene to be employed. In 468 Sophocles introduced a third actor, and the number never went beyond this. Æschylus adopted the improvement, and in his great Orestian trilogy ("Agamemnon, Chöephori, Eumenides") uses the triple action again and again. In one instance we seem to see a place in "Œdipus at Kolōnos" where Sophocles must have needed four actors; but on examination a mute figure dressed for Ismene will be found sufficient, for though she moves in that scene she does not speak, and as will be seen presently the masks and costumes would effectually prevent the substitution of one actor for another being perceived when the voice did not betray him. Learned men have amused themselves with allotting the parts of the play; thus Schöll shows that in the "Aias" (Ajax) the first actor played Aias and Teukros; the second actor played Odusseus, the messenger, and Menelaos; and the third actor played Athena, Tekmessa, and Agamemnon. The actors were always men: and the choral odes, among the many purposes which they answered in the construction of a Greek drama, served to give time for the change of dress which this multiple personation required. The chorus of the dithyramb was always fifty, and possibly at first this number was adhered to; but its unwieldiness induced Æschylus to reduce it to twelve. Sophocles raised it to fifteen, at which it remained. To Sophocles also was due the final arrangement of the choric dance. The chorus entered from the right "wing" in three lines, their song and dance accompanied by flutes and lyres, and their movements governed by marks chalked on the floor of the orchestra. The number

of a comic chorus was twenty-four, and the dance was of quite a different character. When a poet wished to bring out a play he applied to the archons, and if his play was thought well of he was decreed a chorus, the expenses of which, including maintenance of the singers during the long training, were borne by the *choregos* of his tribe, elected for that special purpose. He then entered into the competition with other dramatists, each writer usually training his own actor and chorus, assisted by a chorus-master. Originally the dramatist (like Shakspeare) was an actor too; Æschylus is known to have acted Prometheus and Agamemnon. Sophocles broke through this rule, for his voice would not fill the theatre, and it was not revived. The plays were performed in public before judges chosen and sworn; and the choregos whose play won the prize received a tripod, which he usually consecrated and erected in the "Street of the Tripods," on a suitable base with inscription, &c. The choregos was, as it were, the lessee, who bore the expenses and ran the risk of the competition in the name of his tribe.

A simple drama was not sufficient. The poet had to produce three tragedies (a trilogy) and one comedy, or rather farce, all on connected subjects, though each was complete in itself. The whole was called a *tetralogy*. If all the ten tribes contended each year there would be ten tetralogies produced—thirty tragedies and ten farces! Probably this is widely beyond the truth, still the number was really very great. We know of seventy-five plays of Æschylus, of 113 of Sophocles (eighty being prize plays), and of ninety-two of Euripides, and each wrote others of which we do not know. But beyond this we know that a poet, Philocles, beat Sophocles, even against the Œdipus trilogy, though that seems almost incredible; and that Euphorion (son of Æschylus), Iophōn (son of Sophocles), Xenocles, and Nikomachos, all beat Euripides at various times. We know, too, of Agathōn, Iōn, Neophrōn, Achaios, &c., and the whole of these wrote in the one century—from Æschylus, beginning B.C. 499, to Euripides, ending B.C. 405. And further, we have only a handful of plays of three great men, each of whom was now and again beaten by others, and in some of these very plays. This handful is yet to us most precious—it has served for models for generation after generation of poets, even to our own day, when we see a Swinburne writing "Atalanta" and an Arnold "Meropē." What a blaze of splendour, therefore, must the whole Greek drama collectively have been! The thought of what we have lost is too tantalizing to dwell upon.

In the earlier part of the century represented to us by Æschylus the subjects are ideal, vast, and majestic; the language which fits these conceptions is magniloquent almost to "fustian," but later the perfect drama of Sophocles brings us face to face with man and with actual emotions and simple speech. Finally the growing schools of philosophy and rhetoric invade the stage; love tales on the one hand, and wire-drawn philosophizings on the other, lower the lofty tone of the elder poets. This period, led by Euripides, was even thought irreligious in its all-questioning attitude by many of the conservative citizens.

Comedy came fully half a century later to any degree of excellence (Cratinus wrote about 450), and Aristophanes, its great pride, and most unhappily the only writer whose works have come down to us, did not begin to write until 427. The field of comedy was actual life. It was the farce of the tetralogy applied, not to the persons of myth and legend, but to living men. Socrates, Cleon, &c., of such characters does the comedy consist; and their leading peculiarities are held up to merciless ridicule. A later comedy, with Menander (Menandros, born 342, died 291) for its chief exponent, came on about a century later, and abandoned the old libellous burlesque of living personages for ridicule of types well known to ancient manners. We know Menander through Plautus and Terence, and hence through Molière.

From this cursory survey of the drama from the poets' side we pass to its external conditions. Every one, even the poorest, were admitted. At Athens 30,000 could be held in the theatre, and at first all seats were free; but it was soon found necessary to make a charge to keep the assembly more orderly, and eventually the theatre was given over to a lessee, who kept it in good condition, paid a fixed rent for it, and was entitled to receive fees. But as the rich outbid the poor, and these latter could not find room, Pericles fixed the price of seats at three *oboloi* for the best seats and an *obolos* for the more distant. The representation covered two days; and since the demagogues led the people to clamour even against this moderate fee, a public distribution was ordered of two oboloi (say 2½*d.*) to every citizen who chose to receive it, whether rich or poor. Frequently the money reserved for the emergency of a war was thus squandered, and this expenditure always formed the heaviest item of the annual budget. The plan of the theatre—a vast semicircle usually in the side of the hill, the rows rising one above the other, cut in the earth and lined (or at any rate in the principal rows) with wood or marble—permitted all to see the stage, stretching across and forming the chord of this great arc. It was open to the sky, and the vast assemblage in their gay dresses under that lovely blue sky must have formed an imposing sight. The spectators (mostly men) began to assemble at early dawn to secure good seats; women, if any came, sat apart. No women were allowed to come to comedies. Favourite actors were applauded with clapping of hands and cheering, and flowers were thrown to them; actors who failed to please were hooted and hissed, if indeed no worse befell them. The excitability of an Athenian audience was quite proverbial; and not a single slip was allowed to pass their keen scrutiny unnoticed.

The plan of the theatre shown in the Plates on GREEK ARCHITECTURE carries its own explanation to a great extent. Of the three doors at the back, the scene generally representing a royal palace, the middle one was for the king alone, and the side ones for his guests or visitors. The side entrances (at the "wings" as we should call them, only they were at the level of the orchestra) were held to be respectively the road to the city and the road to foreign countries. An actor arriving from afar entered the orchestra thus by the "wing," and then ascended by steps on to the stage. The orchestra was the domain of the chorus, and in the midst of it was the altar (*thymele*) of Dionysus. If necessary the chorus ascended to the stage by steps. The stage was considerably above the orchestra; and this allowed personages supposed to come from the infernal regions to come forth from beneath it and ascend to it through a trap door to take part in the drama. Gods of Olympus, on the other hand, descended from above in "machines" let down by a crane (examples yet exist of all this). Every pains was taken to make clear the character of each actor by his very mode of entry.

The scene opened in the middle when a change of scene was desired, as when in "Antigone" we are transported from the outside to the inside of the palace at the catastrophe. Besides the back scene there were side scenes, which had a triangular shape, and revolved on their axes. The three sides being suitably painted gave the power of three changes of side scenes to the dramatist. By this means, leaving the scene itself untouched, he could indicate the change of the direction of the "foreign road" or an entire change of locality to a different palace from the first, &c.

The costume of the actors was to our modern tastes most inconvenient. The grotesque jocularities of Dionysian worship, staining the face with wine lees, &c., "dressing up," in short, first gave the idea of wearing masks; and this was taken advantage of to increase the size of the

features, and thus render them visible to the large assembly of the ancient audiences. Small holes, only as big as the pupil of the eye, enabled the actor to see through the mask, which fitted right over his head, and the mouth was adapted to form a sort of speaking trumpet, that his voice might be better heard. The size of the actors was further increased by thick boots called buskins or cothurni (*kothornoi*), which raised them, as it were upon clogs, by several inches.

GREEK EMPIRE. Historians led by Gibbon in his unrivalled "Decline and Fall of the Roman Empire," and novelists led by Scott himself in "Count Robert of Paris," unite to pour out vials of contempt upon the Greek Empire, or Eastern Empire, or Byzantine Empire. By these titles is popularly known the remnant of the universal dominion of Rome, after Rome itself had fallen into barbarian hands. But these emperors called themselves Romans, and Greek Byzantion was renamed "New Rome," to be their capital, though from a flattering memory of the first Christian emperor it came eventually to be called Constantinople. Truly the Roman tradition was not much more than a name, and in the decay of the classic civilization, before as yet the feudal civilization had supplanted it, much confusion necessarily occurred. Sometimes the hereditary spirit would prevail, and would inflict misery upon the Eastern Empire in the shape of incapable rulers where the battle was to the strong alone; at other times the throne was the sport of chance—whoever could seize it and hold it, he was emperor till another arose stronger than he. Yet this is the empire to which we owe Santa Sophia and the marvels of Byzantine art, the *Corpus Juris* and the rest of the legislation of Justinian; which preserved Christianity till Rome revived again; which later on withstood for centuries the "unspeakable Turk," in many and various shapes of him, while except with occasional and useless crusades the rest of Christendom left it alone in the continual struggle; and finally which endured, with all its faults, for the long space of 1058 years (from A.D. 395 to 1453). The western branch of the empire came to an end in A.D. 476; and if we count from B.C. 27, when Octavian was called Augustus, Rome was therefore an imperial city for 503 years—only half the duration of the imperial power of Constantinople, though it may have been incalculably more magnificent and great.

It is manifest then that the Byzantine domination was a very real, lasting, and useful power, although its continual frippery of parade, its empty titles, its feebleness on great occasions, its elevation of trickery and falseness into state principles, continually annoy and disgust the student. It must be taken as a whole rather than in detail if one is to search for anything good to say of it.

Diocletian (at the close of the third century) was the first Roman emperor who habitually governed elsewhere than at Rome. He selected Nicomedia as his capital, and his colleague Maximian dwelt at Milan. Constantine, when he became sole emperor in 323, fixed the capital of the Roman Empire at Byzantion, an old Greek city on the Bosphorus, enlarging it and calling it New Rome. (As said above, Constantine's own fame named it afresh "Constantine's city," *Constantinopolis.*) Constantinople was therefore a Christian city from its first foundation, since Constantine was a Christian, the first emperor to embrace the new faith. Also by the prestige of the imperial residence it attracted to itself the best Greek culture of Antioch and Alexandria, and became the metropolis of knowledge as well as of secular authority and of faith. It was under Constantine that the Nicene Creed was drawn up at Nicæa (Nikaia) in Bithynia, the first great general council of the church. By the time of the death of Theodosius the Great, in 395, Christianity was not only the personal religion of the emperors, but was the established religion of the state, and the public profession of paganism was put an end to.

There had been many times a division of the empire, but the division which took place at the death of Theodosius proved final. Honorius was monarch of the Western Empire; Arcadius was the sovereign of the now far more important East. By 410 the Visigoths under Alaric had taken and sacked Rome, and the Roman legions had been for ever withdrawn from Britain to join in the death struggle. At last, in 476, with Romulus "Augustulus" the succession of Western emperors came to an end; and the way in which this was done is significant. As when the empire began all republican forms were steadily maintained, so now, although the barbarians had definitely assumed power in Italy, Roman forms and titles were still kept up. The Roman senate voted that the empire should again be one. Zeno (474–491) was then on the throne at Constantinople, and Zeno therefore was to be sole emperor. At the same time he was obliged to appoint a patrician of Rome (as one might say, a viceroy), and this patrician with unlimited powers was the barbarian chief Odoacer. So it was also in France where Chlodwig, conquering old Gaul, sought and obtained the Roman proconsular dignity from the Eastern Empire, and indeed was absolutely consul in 510. And when in 489 Theodoric at the head of the Goths (East Goths or Ostrogoths) entered Italy, he was careful to obtain the deposition of Odoacer and the appointment of himself from Constantinople. Theodoric reigned over Italy as patrician from 493 to 526. He was king not over Italy, but over his own Goths, so that it is not quite accurate to call his rule, as is sometimes done, the Gothic kingdom of Italy. Under his rule Italy was the most flourishing state in the world at the time. Theodoric held a vast territory in sway, the Gothic rule extending over much of Central Europe; and during the minority of his grandson he was regent over the Visigothic kingdoms of Southern Gaul and of Spain.

Meanwhile the Roman Empire so called, and by all men so considered, went on, with Constantinople as its centre. The Roman laws and titles were unaltered, and all official acts were in Latin, though Greek came more and more to be the language of the people there. The reigns of the early Eastern or Greek emperors from Arcadius to Justinian offer little of general interest. Continual struggles against the revived Persian monarchy, and a life-and-death contest with Attila and the Huns, are the main features. But the church historian finds a rich field. Heresies sprang up like weeds in the teeming Oriental soil, and the councils were frequent (Ephesus 431 and 449, Chalcedon 451, &c.). The patriarchate of Constantinople, though always subject to the emperor—in this differing essentially from the future pontificate of Rome—rose to great authority, practically supreme over the whole Eastern Church; and one of its patriarchs was John called *Chrysostom* (Golden-mouth), one of the best known of the Greek "fathers."

At Theodoric's death the great dependency of Italy was left practically masterless: the Vandals' kingdom in Africa also was weak. At this time therefore Justinian, who reigned from 527 to 565, made a desperate attempt to recover the actual sovereignty over both. He had in Belisarius one of the greatest generals who ever lived. Belisarius first had to give the Persians such a severe check as to keep them quiet during his absence. Then he overthrew the Vandals (534), and the next year landed in Italy, and in a few campaigns brought it to the point of subjection. Justinian's jealousy recalled him, and handed over the completion of his work to Narses. By 558 Italy was firmly an integral part of the empire, with Narses as exarch or viceroy. Santa Sophia, the glory of Byzantine architecture, was dedicated at Constantinople in 537. The famous code of Justinian, the Corpus Juris, was of course no more due to the emperor than were the victories of Belisarius and Narses, but it permanently ennobles his name. It even to this day forms the basis for the law of practically

all Europe. Far less enduring were his conquests. They scarcely lasted till the end of his reign; and three years after his death (568) saw the whole of North Italy and a great deal of the south also in the hands of the Lombards, a powerful Teutonic tribe. Ravenna only remained, the capital of the imperial exarchate, and Rome shrunken and desolate, and the large islands; the rest was barbarian. Venice, springing up among the small islands and marshes at the head of the Adriatic, peopled with refugees from the invading Huns, was nominally a city of the empire, but really very soon effected a semi-independence. Though so much had been lost the empire still possessed the greater part of the Mediterranean lands, and all the chief imperial cities of the three continents, at the close of the sixth century. This yet large dominion was, however, threatened on all sides. The Lombards encroached on the west, the Slavs and Huns on the north, and on the east the Persians and a new Turanian race called the Turks. These last, the destined destroyers of the empire, appear in the reign of Justinian. One branch of them, the Avars, from 594 to 620 threatened the empire with annihilation, and the considerable ability of the Emperor Maurice the Cappadocian (582–602) alone sufficed to check them. This danger over, the Persians under Chosroes, a grandson of Chosroes Nushirvan, the old opponent of Belisarius, overran the Asiatic provinces of the empire from 611 to 615, and encamped in the very sight of Constantinople, only separated from it indeed by the narrow strip of sea dividing Europe from Asia. The Emperor Heraclius (610–641), resolving on a supreme effort, restored the severe discipline of ancient Roman armies, and as soon as his levies were fully disciplined led them against the Persians. In unceasing campaigns, lasting from 620 to 628, he won back the Persian conquest, and indeed effectually broke up the power of Persia. This great war, absorbing all the energy of Heraclius, left the Gothic kings free to resume their power in Spain, however; so that what the empire won at one end it lost at the other.

We now come to the remarkable rise of Mohammedanism and the great Arabian power of the Saracens. The flight of Mohammed from Mecca to Medina—the Hegira—from which Mussulmans date their existence, occurred in 622. In a few years the new religion he preached had spread like a fire through Arabia; and with their triple alternative, *the Koran, tribute, or the sword*, not only did his followers hold Arabia, but a great deal of Asia also. At Mohammed's death (632) his successors (caliphs), who like himself were pope and emperor in one, proceeded to attack the empire. Heraclius, who could beat the Persians, was no match for the fiery fanatical Arabs. He was defeated at Aignadin in 633, at Yermuk in 636, and at Alexandria in 640, and one by one Syria, Egypt, and most of the Greek provinces in Africa fell to the Mohammedans between this and the year 648. Besides Alexandria, Antioch was Mussulman; and what was far worse, the sacred Jerusalem itself. Carthage fell in 698, and all the southern coast of the Mediterranean was theirs by 709; every trace of the Roman or Greek dominion and of the once great kingdom of the Vandals was swept away as if they had never been. In 710 the Saracens crossed the Straits of Gibraltar into Spain, and in scarcely more than three years they utterly subdued it, and it was not till seven centuries later that they were driven out. East, south, and north of the Mediterranean had thus passed from Christian to Mussulman hands, from the Greek Empire to the Saracen. Persia, Scinde, and the Turkish tribes beyond the Oxus, rapidly fell in succession before the all-conquering caliphs. The great empire did not hold together for long, and the caliphs of Spain, of Damascus, and of Bagdad divided the Mohammedan dominion, the latter being always regarded as the chief.

The Emperor Constans had purchased peace from these dreaded Saracens in 660; but peace was impossible between Christian and Mussulman at that age of the world. In twelve years the sieges of Constantinople began. For five years, 672–677, did the Saracens invest the city with little intervals of repose; and the very next year after they eventually retired the savage Bulgarians, a mixed Turanian and Slavonian race, conquered the land beyond the Danube, which they still hold, and began ravaging the country between that and Constantinople, penetrating as far as the walls of the city in 711. The Bulgarians being bought off and driven off, the Saracens recommenced, and Constantinople had to stand three more attacks from them (716, 718, 720), in the last of which they were so worsted as to induce them to leave the empire at peace for a time. This was the work of Leo (718–741), a valiant Isaurian, who had assumed the throne after the period of confusion succeeding the failure of the line of Heraclius. It is not too much to say that if Leo had not held off the Saracens all Europe would have become, at all events for the time, Mohammedan; for no power as yet existed, save the empire alone, which could have withstood the Saracens.

The same religious force, however, which had inspired Leo against the infidel inspired him against those whom he considered heretics; and in 726 he forbade by edict the worship or adoration of images. This roused a fierce opposition in the church, particularly in the Western Church, now growing more and more under the power of the bishops of Rome. Leo's son, Constantine Kopronymos (741–775) vigorously continued the iconoclastic policy, and in 754 ordered all images in the empire to be destroyed. In Italy men fell away partly through other causes, chiefly through this, and the popes led them. The exarchate of Ravenna was lost through their dissensions (the Lombards taking it in 752), Dalmatia was lost in 825, Sicily and Crete in 827, and all the time the weary religious controversy went on as if men had not more pressing work. Image worship was restored by the Empress Irene (for which she was canonized) in 787, but was persecuted in 830; restored in 812 only to be forbidden by the Council of Constantinople in 869, and that decree too was upset by a following council in 879.

It has been said that the Lombards took Ravenna from the weak hands of the empire in 752, but they did not hold it long. Pope Stephen III. prevailed on Pippin the Short, the first Karling king of France, to come and save Rome, then in danger from these conquerors. Pippin crossed the Alps, and soon reconquered the exarchate, styling himself Patrician of Rome. His son Karl, Charles the Great (Charlemagne), finished the overthrow of the Lombards in 774, and took the style of King of the Franks and Lombards and Patrician of the Romans. Charles ruled all Italy except the south.

In 792 the Empress Irene deposed and blinded her son, the Emperor Constantine VI., and avowedly assumed the sceptre she had long wielded in effect. No woman had ever been titular sovereign before, and the innovation was made the pretext for Italy throwing off the yoke. Charles, German though he was, was crowned emperor at Rome in 800 by Pope Leo III., and once again the Roman Empire was divided. Each empire called itself the true Holy Roman Empire, though we find it better to call one the Empire of Germany and the other the Greek Empire. South Italy remained for two centuries longer in the possession of the Greek emperors, but the rest of Italy never again was theirs.

At this time the Mohammedan power chiefly resided in the two great caliphates, Bagdad and Damascus, and these two Saracen empires and the two Christian empires ruled the greater part of the civilized world between them. Britain alone was independent. Independent Saracen powers soon arose here and there, as in Sicily and Crete, for instance, in the ninth century, at the expense of the Saracen or the Eastern Empire. So also did the

Frankish Empire break in pieces shortly afterwards, and mediæval Europe began to take somewhat the shape as we know it.

After Irene there were emperors of the East of different families and of widely varying powers, tested by the keen touchstone of the incessant resistance to the Saracens. Towards the close of the ninth century the strong Basilian (Macedonian) dynasty arose, under Basil the Macedonian, in 867. Bit by bit lost territory was regained, until by the time of Nikēphoros Phokas, the reconqueror of Crete (963), the empire was at its strongest point after the final separation. Nikēphoros was murdered by the next emperor, John Zimiskes (969), who was a still more famous general, and his colleague and successor, Basil II. (976), recovered Antioch and drove back the Saracens. He also conquered the Bulgarians (987), and carried the frontier once more to the Danube and the Euphrates. John Zimiskes in 973 had had also to cope with a new Slavonic power, the Russians, already strong enough to make a dash by sea at Constantinople. In the middle of the eleventh century Norman adventurers pressed into South Italy, and under Robert Guiscard the whole of the possessions of the Eastern Empire were wrested from it. Sicily fell before them in 1063, and the Normans ruled it as a county until under Roger II. it became a kingdom. A curious kingdom it was, ruled by a handful of Norman Franks, and the people half Saracens and half Greeks.

Meanwhile in Asia the Saracen sway had yielded to that of the Seljuk Turks; and this new Mohammedan power lost no time in attacking in its turn the devoted Eastern Empire. In 1071, at Manzikerk the Turkish Sultan Alp Arslan gained a great victory, and took the Emperor Romanos IV. prisoner. The whole of Asia fell, and the Turks held even to the southern shore of the Hellespont. But as the Turkish state was shortly after torn by dissensions, while the Eastern Empire was rising from its reverses under Alexis I. (ascended 1081), best of the Comnenian emperors, it was felt by all the Christian world that a good opportunity had come to strike for Jerusalem. Pope Urban II. listened eagerly to the exhortations of Peter the Hermit, and held a council in 1094 at Clermont in Auvergne, when the *Holy War* was decreed.

This Holy War soon came to be called a crusade (*croisade*) as the soldiers wore a cross (*croix*) embroidered on the shoulders in token of the object of the war. Not only the title, but the soldiers of the first Crusade were so largely French that *Frank* is the name for Western nations among Orientals to this day. Jerusalem was taken in 1099, and held for nearly 100 years by "Latin" kings of Jerusalem. Alexis also was not idle. He regained the coasts of the Euxine and Ægean seas, and a great deal of inner Asia Minor in 1097 and onwards. The second Crusade, preached by St. Bernard in 1147, was to help the kingdom of Jerusalem against its enemies; and the third was that famous expedition to try and win it back after it had been lost, the parts of Richard Cœur de Lion and Philip Augustus of France in which all know so well. Their antagonist, the Sultan Joseph, better known by his surname of *Saladin*, had taken Jerusalem in 1187, and had in fact restored all Syria and Egypt to the power of the Caliph of Bagdad. The fourth Crusade never touched the Holy Land at all, contenting itself with overthrowing the Greek Empire instead. The crusaders came to Venice to ask for ships to take them to the Holy Land. Venice, now completely independent, agreed to lend ships if the crusaders would first conquer Zara in Dalmatia for the republic. This was faithfully done, and the armament then sailed for Constantinople. Here they found an usurping emperor Alexis, who had blinded his brother and sovereign Isaac II., and had thrown him and his son Alexis Angelos into prison. These were restored as Isaac II. and Alexis IV. by the crusaders in 1203. But another Alexis, Alexis Dukas, heading a revolt as soon as the crusaders had gone, overthrew and slew Isaac II. and Alexis IV., and himself reigned as Alexis V.; whereupon the crusaders returned, besieged and took Constantinople, put Alexis V. to death, and set up a "Latin Empire" of the East in place of the Greek one. Baldwin, count of Flanders, was the first emperor, and the other great chiefs got large slices of the empire for their share of the plunder, while what belonged neither to Emperor Baldwin nor to the others was ruled over by petty independent chieftains or "despots." The best of these ruled in Epirus and at Nicæa (Nikaia) in Asia. The despot of Nicæa, Theodore Laskaris, called himself emperor, and so solidly established himself that in 1261, one of his successors, Michael Palæologus (Palaiologos) was able to regain Constantinople, and in name at least restore the Greek Empire. It was a very restricted sovereignty compared to what it once was, many of the independent states being strong enough to retain their liberty. One of them, the empire of Trebizond, outlasted that of Constantinople itself. The crown, such as it was, remained with hardly any interruption in the hands of the Palæologi till the end came in 1453.

The invasion of the Moguls or Tartars in the middle of the thirteenth century, among its disturbances in Europe and in Asia, overthrew the power of the Seljuk Turks, and gave the Greek Empire a fresh lease of life. But about the same time a tribe of Turks, whose leader was Othman, hence called the Othman or Ottoman Turks, or simply Turks, began to make headway in Asia. They gradually absorbed the imperial provinces in Asia, and in 1299 Othman proclaimed himself Sultan. Turkish pirates now infested the Euxine and the Mediterranean. By 1340 they had ravaged Mysia and held much of Asia Minor, and in 1361 they first set foot in Europe, crossing to Thrace. Advancing under their Sultan Murad (or Amurath) they took Adrianople and made it the Ottoman capital. Constantinople and a few surrounding square miles still held out, and this was all that remained of the Greek Empire. Sultan Bajazet would probably have annexed it, and with his military genius certainly would have inflicted greater disasters upon Europe than his defeat of the Christian army under Sigismund of Hungary (Nicopolis, 1396), had not Timour the Tartar suddenly appeared in Central Asia, and marched westward against Bajazet, whom he considered as a (Mussulman) heretic. He overthrew Bajazet and made the Greek emperor pay tribute in 1402, but himself died in 1405 without crossing into Europe. The Ottoman power did not revive till 1421, when Amurath II. succeeded in re-establishing it. He at once laid siege to Constantinople, but was not able to take it. Succour was now offered by the Pope Eugenius IV., eager to overcome the Council of Basel (in his view schismatic) by some great stroke. He offered to relieve the struggling Greeks if they would become reunited to the Latin Church and acknowledge the pope's supremacy. In the article on EUGENIUS IV., this miserable sham-reconciliation, more shameful to Eugenius than to the wretched emperor, John Palæologus, is recounted. It ended in absolutely nothing; no help was sent, and such submission as was made was at once disavowed. Mohammed II., the Conqueror, son of Amurath II. succeeded his father in 1451, and at once invested Constantinople. Constantine XII., the last emperor, did all he could, even to repeating the shame of his predecessor John, and offering reconciliation with the Latin Church as the price of help. He did in fact receive a few volunteers from Venice and Genoa. But the siege progressed, the first great siege in which cannon played the principal part. Constantine fell, sword in hand, as the Turks entered the city, 29th May, 1453. A Constantine was its first Christian ruler and a Constantine was its last. The Turks at once made it their capital, as it has been ever since, turned the "Holy Wisdom" Church (Santa

Sophia) into a mosque, and speedily reduced such of the Morea (Peloponnesus) into subjection as had retained its allegiance to Greek rule. Mohammed actually took Otranto in Italy as his first step westward, but his death happily prevented that first step from having any successors.

From 1453, for these four and a half centuries, or near it, the "unspeakable Turk" has been a festering sore in south-eastern Europe; and this because the Latin Church, which might have easily saved Christianity from this long shame, was not unwilling to see the troubles of the Greek Church, by means of which she hoped to gain her own end—the ascendency over the whole of Christendom.

List of Emperors of the Greek Empire.—Although so many of these princes are scarcely worth recording, it will be better to give a complete list, with their dates of accession.

Arcadius, son of Theodosius, emperor of Rome, 395; Theodosius II., son, 408; Marcian, a Thracian, 450; Leo I., the Thracian, 457; Leo II., son, 474; Zeno, the Isaurian, 474; Anastasius, an Illyrian, 491; Justin I., son, 518; Justinian, the legislator, son, 527; Justin II., nephew, 565; Tiberius II., son, 578; Maurice, the Cappadocian, 582; Phocas, 602; Heraclius, 610; Constans II., son, 641; Constantine III., Pogonatos, 668; Justinian II., son, 685, deposed 695, restored 705, slain 711 (Leontius, 695; Tiberius III., Aspimar, 698); Philippicus Bardanes, 711; Anastasius II., 713; Theodosius III., 716; Leo III., the Isaurian, "Iconoclast," 718; Constantine IV., Kopronymos, son, 741; Leo IV., son, 775; Constantine V., son, and Irene his mother, 780; Constantine deposed, Irene reigns alone, 797, deposed 802; Nikephoros I., Logothetes, 802; Staurakios, 811; Michael I., 811, becomes a monk and abdicates, 813; Leo V., the Armenian, 813; Michael II., the Stammerer, 820; Theophilos, son, 829; Michael III., Porphyrogenitos, son, 842.

Basil I., the Macedonian, 867; Leo VI., the Philosopher, son, 886; Constantine VI., Porphyrogenitos, son, 911; Rômanos Lekapenos, 919, his sons also reign, five emperors at once, 928; Constantine VII., son of Lekapenos, reigns alone 945; Rômanos II., son, 959; Nikephoros Phokas, 963; John I., Zimisces, 969; Basil II., son of Rômanos II., 976; Constantine VIII., brother, 1025; Rômanos III., Arguropulos, son, 1028; Michael IV., the Paphlagonian, 1034; Michael V., Calaphates, 1041; Constantine IX., 1042 (the abandoned Zoë, wife or mistress of all the last four); Theodora, widow of Constantine IX., 1054; Michael VI., Stratiotes, 1056; Isaac I., Comnenus, 1057; Constantine X., Dukas, 1059; Eudoxia, widow (with Romanos IV.), 1067; Michael VII., Parapinakes, and Constantine XI., stepsons, 1071; Nikephoros III., son, 1078.

Alexis I., Comnenus (Alexios Kômnenos), 1081; John Comnenus, son, 1118; Manuel I., Comnenus, son, 1143; Alexis II., Comnenus, son, 1180; Andronicus I., Comnenus, cousin, 1183; Isaac II., Angelus Comnenus, cousin, 1185, deposed by Alexis III., Comnenus the Tyrant, 1195, restored by the crusaders with his son Alexis IV., 1203, both murdered by Alexis V., Dukas, 1204.

Latin Emperors (*i.e.* of the Latin, not of the Greek Church).—Baldwin, count of Flanders, succeeds on the execution of Alexis Dukas, 1204; Henry I., brother, 1206; Peter de Courtenay, brother-in-law, 1216; Robert, son, 1221; Baldwin II., brother, 1228; John de Brienne, associate, deposed 1261.

Greek Emperors.—At Nicæa. Theodore Laskaris I., 1204; John Vataces, son, 1222; Theodore Laskaris II., son, 1255; John Laskaris, brother, 1259; Michael Palæologus with him, 1260.

At Constantinople. Michael VIII., Palæologus, reigns alone, 1261; Andronicus II., son, 1282; Andronicus III., grandson, 1328; John I., Palæologus, 1341 (Cantacuzenus, regent, proclaimed 1341, abdicates 1347); Manuel II., Palæologus, son, 1391; John II., Palæologus, 1425; Constantine XII., Palæologus, brother, 1448—killed at the taking of Constantinople by the Turks, 1453.

GREEK FIRE was the name given to a composition which was largely used by the Greeks of the Byzantine Empire in their wars with the Mohammedans. Its nature was kept a profound secret for centuries, but the material is now believed to have been a mixture of nitre, sulphur, and naphtha. It burned with terrible fury wherever it fell, and it possessed the property of being inextinguishable by water. Even when poured upon the sea it would float on the surface and still burn. It was used in warfare for a considerable time after the discovery of gunpowder, but gradually fell into disuse as artillery became more effective. The name is still sometimes used to designate the inflammable compounds known to modern chemists which have been designed for use in incendiary shells, and for a composition which has been used by the Fenians to set fire to public buildings.

GREEK LANGUAGE AND LITERATURE. Greek is a member of the Aryan family of languages, otherwise called Indo-Germanic, a term roughly indicating their geographical range previous to the discovery and colonization of the New World. Of these Sanskrit and Zend are, speaking generally, the oldest and most archaic (or best preserved) in form, and modern English is on the whole the most recent development. These statements must, however, be received with considerable qualification, and no less must the assertion that Greek comes nearest to Sanskrit in approximation to the supposed original stock or mother-tongue of the Aryans be taken with some reserve. The relations of the various languages of a given group to the parental type may be best illustrated by the analogy of manuscripts. The three leading MSS. of the New Testament, known as the Alexandrian, the Sinaitic, and the Vatican respectively, furnish, especially by their consensus, the most reliable test. But a large consensus of later MSS. may establish in given cases a more ancient reading than any or all three of them supply. Or further, a reading may be ancient in one respect and modern in another—*e.g.* the words may be genuine, but the spelling may be corrupt. To apply this illustration to the subject of this article, Greek on the whole is more archetypal than Latin in its vocabulary and grammatical forms. In the Greek word φέρεται we have a nearer approach to the Sanskrit *bhâratê* than in the Latin word *fertur*, where in particular the ending *ur* is a later and independent formation. But on the other hand, φ standing for *bh* illustrates a prevailing departure of Greek from the Aryan original—viz. the consistent substitution of an aspirated tenuis for an aspirated medial, seen not only in φ for *bh*, but equally in χ for *gh*, and θ for *dh*. If it be asked how do we know that in these cases the medial aspirate is older than the tenuis, the answer is—by the general consensus of the other allied languages, for χ, θ, φ in Greek answer not indeed to *gh*, *dh*, *bh*, which Sanskrit and Zend alone, and that not uniformly, preserve, but to *g*, *d*, *b* respectively in Gothic and all the Teutonic tongues, as well as in Slavonian and Lithuanian, Albanian and Celtic, and even, so far as regards the occurrence of the sound in question in the middle of a word, in Latin. So we may say that Greek is older than other languages in so far as it keeps an aspirate which they have lost, but they are older than Greek in so far as they keep medials which Greek has transformed to tenues. For a full exposition of the relations of the main branches of the Aryan languages to each other see August Schleicher's "Compendium der Vergleichenden Grammatik der Indo-germanischen Sprachen" (Weimar, 1866), and Curtius' "Grundzüge der Greichischen Etymologie" (Leipzig, 1869).

The Greek language, in the most ancient literary monuments of it which have come down to us, presents us with

several dialectic forms. Of these the most important are the Ionic, the Æolic, and the Dorian.

The *Dorian* dialect is chiefly remarkable for its breadth of vocalization, the vowel *a* being of far greater frequency here than in the other dialects. It also often represents the Sanskrit combination *δj* by δδ, instead of by ξ. Example:

ἄμβατι πὸτ τὰν μάδδαν αἰ εὕρητί πα,

which in classical Greek would stand

Aristophanes in his "Acharnians" gives the above as a specimen of the country brogue of Megara. Other varieties of Dorian are the Laconian (Spartan), the Elian, and the Bœotian. Further features of the Dorian are the use of τοί, ταί for οἱ, αἱ, plural masculine and feminine of definite article, and archaic forms like τύπτοντι for τύπτουσι in the third person plural of verbs. The Bœotian is especially rich in the sound οι, which later dialects represent by υ.

The *Æolian*, besides many archaisms common to it and Dorian, is noted for one remarkable innovation—viz. the dropping of the aspirate before ὑ—*e.g.* ὐπὶς for ὑπὶς—while it clings with peculiar tenacity to the digamma (Ϝ), equal to *v* or the consonantal *w*. It also approximates to Latin by dropping *s* as a sign of the nominative masculine in the so-called *a* declension—*e.g.* Æolic ἱππότα, Doric ἱππότας, Attic ἱππότης.

The *Ionic* is the most important literary dialect of Greece, especially in its later or Attic form, as the language of the leading literary people—viz. the Athenians. In its older form it displays a marked preference for η over α, as we see in Herodotus, whose history was written about 425 B.C.; but in Attic this tendency is so far restrained that α is the favourite vowel after ρ or ι, while η is preferred in other places as a feminine termination. The so-called New Attic, the language of Xenophon (who wrote the "Anabasis" about 394 B.C.), preferred ττ to σσ for Sanskrit *tj*, but in the common dialect (ἡ κοινὴ διάλεκτος), which was the final outcome of the merging of provincialisms by the Macedonian conquest, this specialism survived only in a few words—*e.g.* πράττω for πράσσω (but conversely, διατάσσω for διατάττω). As compared with the older dialects Attic abounded in contractions—ἀγαπᾷ for ἀγαπάει, ἱππεῖς for ἱππέες, and so forth. The earliest and most archaic form of the Ionic dialect is that found in epic poetry. Here relatively uncontracted words abound, the definite article is as yet almost unused, and the digamma is in full force, though this is not apparent from the MSS., but only from the scansion. The poems ascribed to Homer (about B.C. 850) and Hesiod (about B.C. 750) are the best examples of epic. In lyric poetry (Pindar, about B.C. 450) during the Attic period the Doric dialect survived, and was afterwards artificially used in the so-called pastoral verse, the Bucolics of Moschus, Bion, and Theocritus, during the Alexandrian period (about B.C. 275). But the Ionic dialect was the language of the early chroniclers (λογογράφοι), whose writings, as those of Kellanikos, Strabo describes as poetry divested of metre, and in its Attic form it became, during the splendid era of the fifth century B.C., in the hands of the tragedians and comedians, Æschylus, Sophocles, Euripides, Aristophanes; the historians Thucydides and Xenophon and their successors; the philosophers Plato, Aristotle, and Theophrastus; and the orators Demosthenes, Æschines, Socrates, Hyperides, of the fourth century B.C., with inconsiderable variations, the literary language of Greece. Henceforth Attic was the standard of a correct style for ordinary prose purposes, and under the Ptolemies at Alexandria (covering the last three centuries B.C.) imitation and artifice became the order of the day. In prose imitation Attic, in lyrics and bucolics imitation Doric, in heroic and elegiac verse imitation Epic was the prevailing Alexandrian fashion. Meanwhile the spoken language of the common people was called Hellenistic Greek, or the common dialect, the general line and tone being Attic, but with a tendency to a simplified grammar and the adoption of many non-Attic forms. After discounting obvious Hebraisms a fair notion of the salient features of their common Greek may be gained from the Septuagint translation of the Old Testament, made at various times between 300 and 200 B.C. Here we have already the germs of what is called Modern Greek. A tendency observable already in Aristophanes (who gives us the talk of the market-place) to substitute diminutives for primary forms; the occurrence of provincial archaisms not found in classical speech; the abandonment of grammatical expedients not serving any indispensable practical purpose—*e.g.* the dual number and the optative mood; the gradual usurpation of the functions of the perfect tense by the aorist; an increase in the use of prepositions, and a corresponding economy in case-endings; and generally the substitution of an explicit for a terse mode of diction (ὅτας or ἵνα βάλω for βαλεῖν, and the like), mark the inevitable transition from the ancient to the modern manner alike of thought and expression. See this exemplified more in detail in "The Modern Greek Language in its Relation to Ancient Greek," by E. M. Geldart (Oxford, Clarendon Press Series, 1870). Sophocles' "Greek Lexicon of the Roman and Byzantine Periods" (Boston, 1870), and the same author's "Glossary of Later and Byzantine Greek" and "Modern Greek Grammar," may also be advantageously consulted. The further development of the modernizing tendency may be traced in "Polybius" (second century B.C.) and in the New Testament.

If anyone desires to form a notion of the state of the spoken or vernacular language as contrasted with artificial or classical standards, about 180 years after Christ, no book will be likely to prove more instructive than Sobeck's edition of Phrynichus, the "Eclogæ" and "Epitome." This grammarian set his face like a flint against the employment of non-Attic forms. And it is astonishing to see how nearly every usage against which he protests has finally established itself in the modern language of Greece. One may instance such words as νερὸν (now νερόν) for ὕδωρ, φλούδιον (now φλοῦδι) for φλοιός, κρύβω for κρύπτω, &c. A Nubian inscription by a king Sileo, in Böckh's "Corpus Inscriptionum" (iii. p. 486), may serve as a type of the Greek spoken in Ethiopia in the age of Diocletian (A.D. 284–305). So far as it is not merely barbarous it displays many notable modernisms, e.g. the disuse of verbs in μι, the employment of ἀκμὴν, found also in Polybius, for ἔτι, now ἀκόμη or ἀκόμα, ὅλων for πάντων, and an exuberant use of prepositions. From the age of Diocletian we pass by an easy transition to the Byzantine period. Byzantium under Constantine (sole emperor A.D. 323) and his successors was called Νέα Ῥώμη, New Rome; hence the origin of the term Romaic to designate the vernacular of the later Greeks. The same divergence between the language of the people and the language of literature prevailed under the Byzantine as under the Alexandrine dynasty. Grammarians and ecclesiastics vied with one another in writing a spurious Attic, but little by little the vernacular crept into the works of the latter, especially in such documents as the "Gospel of Nicodemus" (end of fourth century) and the "Apothegmata Patrum," "Acts of the Council of Constantinople," 536 A.D. From the beginning of the seventh century to the close of the eleventh learning was at a low ebb, and a good scholar was so rare a phenomenon that it was believed by the superstitious that the learned Photius had received lessons in the black art from a Jewish sorcerer (Sophocles). Isolated modernisms appear in the writings of Theophanes (758–806), Malalas (of uncertain age), Leo V., the Armenian (813), Leo VI., the philosopher (886–911), Theophanes Continuatus

and Cedrenus (1057), also in quotations by Anna Comnena, who wrote a history of the Byzantine War about 1100. Frequent reference is made by many of the Byzantine writers to this spoken dialect, the language of the common people; but imperfect as the scholarship of most of those authors is, insensibly as their speech is obviously infected by the language of the vulgar, this is never allowed to rise freely and fully to the surface, but is always overlaid by a strained and artificial, though generally barbarous and bastard literary style. All at once, in the person of a poor monk called Ptochoprodromos, what is essentially modern Greek comes forth full fledged, and the change that had been the silent work of centuries is suddenly revealed in a series of popular verses in accentual not quantitative measure, preserved to us by the grammarian Coraes (Coray) in the first volume of his "Atacta." The burden of these verses is the poverty of learned men. They are written with great spirit and remind us of Juvenal. The language of Ptochoprodromos is in all essential respects the vernacular of Greece of to-day: the tendencies traceable hitherto have borne their fruit, and Romaic or modern Greek is the result. The salient features may be thus summed up:—The infinitive has disappeared, save with auxiliary verbs, its place being supplied by particles with the subjunctive. Verbs in *μι* have all become verbs in *ω*. The aorist does duty for the perfect as well as for itself. Most of the participles are supplanted by particles with indicative: "when he had come" taking the place of "having come." The optative mood and dual number are dispensed with. Practically all prepositions are construed with the accusative—one or two compounds only with the genitive. The accusative and genitive also do duty in turn for the dative, which has virtually disappeared. Compound tenses—future, perfect, and pluperfect, so far as the two latter are not expressed by the aorist—take the place of the simple ones of classical Greek. In spite of this vast revolution the great majority of classical forms survive sporadically in isolated phrases. Hence the comparative ease with which those of them that are useful and convenient have been resuscitated in what is called cultivated modern Greek. The limits of this article preclude us from tracing the development of modern Greek literature from Ptochoprodromos onwards; we can only give the names of the leading subsequent and contemporary authors. Such are Meletius (church historian), Chortakis (tragedian), Cornaros (poet), 1561; Rizos, 1743; Rhigas, a patriotic poet; Villaras and Christopulos (lyric poets), 1770; the novelist Soutsos; Vamvas and Vrailas, philosophers; Solomos, Valaorites, Zambelias, Zalacostos, Vlachos, Rangavas, Tantalides, and G. M. Vizyenos, most of the latter still living. For a full account of modern Greek authors see "Geschichte der Neugriechischen Litteratur," by A. R. Rangaves and Daniel Sanders (Leipzig, 1884).

GREEK MUSICAL SYSTEM. There is no doubt but that the Greek musical system was the foundation of our own; but the exact details of their system remained apparently an insoluble enigma until Mr. Chappell's learned "History of Music" put forth its first (and as it proved its *only*) volume in 1874. Without giving the materials of his proof, which is conclusive to anyone able to follow the Greek writers, it will be desirable to set down the results of his careful investigation.

Greek music was based upon the lyre, and as this anciently had four strings the whole system is composed of four notes or *tetrachords*. Following the Latins, we use letters to designate our notes; the Greeks used letters truly to write their notes with, but not to name them by. For this purpose they used the names of the strings of the lyre. In very early times the seven-stringed lyre came into use, and the number of the strings thus corresponding with the number of the sun, moon, and five (Greek) planets, was held to be perfect and mystical. The seven strings were made to cover two tetrachords, by taking the middle string as the last of one tetrachord and the first of the other tetrachord. If the lyre ran over the seven notes which we call in our nomenclature E F G A B♭ C D, this gave the two similar tetrachords E F G A and A B♭ C D, each of which begins with a semitone, E—F and A—B♭ respectively, followed by a tone and then another tone, covering altogether therefore the interval of a perfect fourth (five semitones). The semitone, to begin with, was imperatively necessary to Greek ears. The important note A was the *mesê* (middle string), and answered to our keynote. The others were called *paramesê* (next to mesê, *i.e.* our *b♭*), *paranêtê* (next to nêtê, *i.e.* our *c*), and *nêtê*, the shortest string or treble string—these reckoning upwards. Reckoning downwards next to *mesê* came *lichanos* (the forefinger-string, *i.e.* our *g*), then *parhypatê* (next to hypatê, *i.e.* on *f*), and finally *hypatê*, the longest or bass string. (*Nêtê* really means lowest, and *hypatê* highest, but this is because the lyre was held slantwise, so that the lowest string in position was the highest in pitch; the same thing happens at this day with the violin. To avoid confusion *nêtê* had better be called the treble string.) The whole lyre, when tuned in its natural way, with *mesê* on the middle string, then ran from bass to treble, *hypatê*, *parhypatê*, *lichanos*, *mesê*, *paramesê*, *paranêtê*, *nêtê*; and in the time of Terpander, a famous lyrist who gained the prize for music at the feast of Apollo Carneius at Sparta, B.C. 676, the tuning of this lyre, if our A (A below middle C) was taken as *mesê*, would be, as said above, E F G A B♭ C D. But it is necessary to repeat that these are our names for the notes, the Greeks had no other conception of them than as strings. Any modern musician having the scale as written above shown to him would say at once that it was a fragment of F major; and if one begins on F not E, and transfers the E from the bottom to the top, adding to that an octave F, the actual scale of F major is given. Yet it is manifest that if the piece ends on A, and the harmonies are made to revolve round A as the keynote, a curious kind of minor key is made, differing from our minor by having a semitone to start with, and having what old writers call a *flat seventh*. The seventh in Greek scales was always a tone below the *mesê* or keynote; and all Greek music was in this peculiar minor without exception, both in this conjunct system and in the disjunct system next to be described.

But soon after Terpander's time Egypt was thrown open to the Greeks, having been jealously closed against foreigners till the reign of Psammetichus (685–635 B.C.); and as the Egyptians were well acquainted with the musical use of the octave, this was quickly adopted by the Greeks, and *nêtê* was raised a tone to become the octave from *hypatê*, *paranêtê* being also raised a tone. This left a great gap between paramesê and paranêtê, a gap filled up by a fresh string, which, as it was a third from *mesê*, was called the third-string, *tritê*. At the same time, to keep the fundamental plan of the tetrachord, the string above mesê was raised a half-tone. The effect of all these changes was to give eight strings to the lyre, arranged in two *disjunct* tetrachords, *mesê* no longer ending the one tetrachord and beginning the other, but *mesê* ending the one and paramesê beginning the other a tone above: and the sounds in our nomenclature would be, on the eight-string lyre— E F G A. B C D E.

This is the disjunct system, which for ordinary use rapidly pushed aside the older system of conjunct tetrachords. A glance will show the musician that we have here our minor scale exactly, with the one distinction (fundamental to a Greek ear) of a *flat* seventh. For our taste G in the above scale should be G♯. Also we prefer our scale to run from the keynote to its octave, whereas it is seen that the Greeks liked better to run from the dominant to its octave. When, as in the scale used as a type hitherto, our A (A

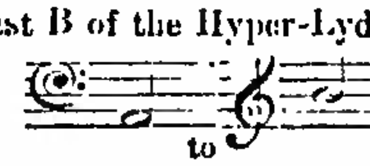
below middle C) was the mesê, the key (which we should call A minor with a flat seventh) was called by the Greeks *Hypo-Dorian*, *i.e.* beneath or sub-Dorian. The *Dorian* (which we should call D minor with a flat seventh) was a fourth above it; and the *Hyper-Dorian*, over or super-Dorian, was yet another fourth above that. Hyper-Dorian would be the same as our G minor with a flat seventh.

There were five such scales or principals, each with its *hypo-* and its *hyper-*, or as we should say its dominant and its subdominant. This difference must however be borne in mind, the Greek dominant (*hypo-*) was conceived as starting a fourth *below* the principal, and our dominant is always conceived as starting a fifth *above*. The musical result is identical, the distinction is only one of nomenclature and arrangement of scale. The converse is the case with our subdominant, which begins a fifth below the keynote, whereas the Greek *hyper*-scale began a fourth above its principal. The following are the scales, with their keynotes in modern phraseology attached:—

DOMINANTS.	PRINCIPALS.
Hypo-Dorian (A).	Dorian (D).
Hypo-Ionian (B♭).	Ionian (E♭).
Hypo-Phrygian (B).	Phrygian (E).
Hypo-Æolian (C).	Æolian (F).
Hypo-Lydian (C♯).	Lydian (F♯).

The respective subdominants were Hyper-Dorian, Hyper-Ionian, Hyper-Phrygian, Hyper-Æolian, Hyper-Lydian, answering to our G, A♭, A, B♭, and B′. It is observable that Hyper-Phrygian, Hyper-Æolian, and Hyper-Lydian are the same scales as Hypo-Dorian, Hypo-Ionian, and Hypo-Phrygian (A, B♭, and B); but the first are an octave higher than the second. Our conception of an unlimited scale was foreign to the Greek. His scale was limited to two octaves strictly. The *mesê* of Dorian was not any D, but the D above middle C (d') and no other, the *mesê* of Hypo-Dorian was a, and not any other A, and that of Hyper-Dorian was g' (the G round which the Treble clef curls), and no other G.

The whole compass of Greek music was therefore three octaves and a tone, from the lowest A of the Hypo-Dorian (A) to the highest B of the Hyper-Lydian (b'')



The way in which this two-octave scale, or "greater perfect system," was arrived at was this:—Taking the two disjunct tetrachords already known to us, and calling them the *tetrachord of mesê* and the *disjunct tetrachord* respectively, we add on a tetrachord, starting from nêtê as a first note, at the top, which we call the *extreme tetrachord*; and we add on another tetrachord at the bottom (always keeping the construction of the tetrachord to the same pattern of "semitone, tone, tone"), taking *hypatê* as the top note of this tetrachord, which we call the *tetrachord of hypatê*. An extra or added note (*proslambanomenos*) will be found to complete the double octave, and to form the lowest note of the scale. Taking as our type, as before, the Hypo-Dorian (of which the *mesê* is a), but it being well understood that the same Greek nomenclature and the same relative system of sounds was applicable to all the fifteen Greek scales or "modes," we may represent the "greater perfect system" as below.

(The letters show the values of these "strings" in modern notation for the Hypo-Dorian mode, where the *mesê* is a; f being Bass F, c' being Middle C, and g' being Treble G. It must be added that the exact translations of the names of the tetrachords would be "tetrachord of the highest strings"—highest in position as the lyre was held, *lowest* in pitch of sound—"tetrachord of the middles," "tetrachord of the disjoined," and "tetrachord of the extreme strings." The nomenclature is slightly altered for clearness' sake. As there are two paramesê strings, &c., the principal one is either called simply *paramesê* or in full *paramesê diezeugmenôn;* and in like manner *lichanos* (g), &c., are either simply so called, or are called *lichanos mesôn*, &c.)

GREEK GREATER PERFECT SYSTEM.

Tetrachord (hyperbolaiôn).	*nete hyperbolaion*, . .	
	paranêtê hyperbolaiôn, .	g'.
	tritê hyperbolaiôn, . .	f'.
Disjunct Tetrachord (diezeugmenôn).	*nêtê*, ...	e'.
	paranêtê, ...	d'.
	tritê, . .	c'.
	paramesê, .	b.
Tone of disjunction.		
Tetrachord of *mesê* (mesôn).	*mesê* (keynote),	
	lichanos, . .	
	parhypatê, ...	f.
	hypatê, ...	e.
Tetrachord of *hypatê* (hypatôn).	*lichanos hypatôn*, ...	d.
	parhypatê hypatôn, ...	c.
	hypatê hypatôn, ...	B.
The added tone or *proslambanomenos*,		

Running contemporaneously with this was a development of the conjunct system, which had no extreme tetrachord, and the upper tetrachord of which was the original conjunct tetrachord which we already know—in the Hyper-Dorian it would have the sounds a b♭ c d. It needs therefore another diagram to show this secondary system, almost exclusively used for sacred purposes.

LESSER PERFECT SYSTEM.

Conjunct Tetrachord (synêmmenôn).	*nêtê synêmmenôn*, ...	d'.
	paranêtê synêm, ...	c'.
	trite synêmmenôn, ...	b♭.
Tetrachord of Mesê.	*mesê*, ...	a.
	lichanos, ...	g.
	parhypatê, ...	f.
	hypatê, ...	e.
Tetrachord of Hypatê.	*lichanos hypatôn*, .	d.
	parhypatê hypaton,	c.
	hypatê hypatôn, .	B.
Added tone or *proslambanomenos*, . .		A.

The values in our nomenclature of these strings as tuned in the Hypo-Dorian mode are given, *mesê* being a, the A below middle C. This system was the older of the two, and the tetrachord of *hypatê* was added by Ion about 450 B.C. The "added tone" came later. It must be noticed that while A, c, and d correspond to the a, c' and d' an octave higher, b♭ is represented in the tetrachord of *hypatê* by B♮! This certainly seems to foreshadow the varieties of the "ecclesiastical" B which ended by giving us our ♭, ♮, and ♯. See ACCIDENTALS.

Hypo-Dorian, the lowest scale, both as giving the lowest tones in music (as was then considered), and also as not extending beyond the high male voice (tenor a' being the top note) came to be so favourite a scale as to be called the "common scale." When therefore organs were built, which were the earliest keyed instruments, their notes were tuned to Hypo-Dorian. That is why the "natural scale" of organs and pianofortes, the scale of the white notes, is Hypo-Dorian, or A minor with a flat seventh. We now consider our keyboard to lie in C major, but major music was a luxury unknown to the ancients. What has puzzled so many children, namely, why the first scale (C) should begin on the third letter, is therefore easily explained. The white notes of the instrument are tuned in the ancient Greek minor, and only by accident contain our modern major.

The reader will doubtless wonder to find Greek music so complete and simple a system when he has been possibly told that every "mode" contained a different arrangement

of tones. This did occur in practice when the ordinary lyre was used, but is at once easily explained. Let there be a lyre of eight strings, that is an octave in compass, from *a* to *a'*, and for simplicity's sake let us desire to play in our modern English keys. We should have, of course, to regard each string in turn as the keynote. If we desire to play in the keys of A, of B, of C, &c., our lyre would have to be tuned afresh for each key thus:—

For A, (*a*) *b* $c\sharp'$ *d'* *e'* $f\sharp'$ $g\sharp'$ *a'*
For B, $a\sharp$ (*b*) $c\sharp'$ $d\sharp'$ *e'* $f\sharp'$ $g\sharp'$ $a\sharp'$
For C, *a* *b* (*c'*) *d'* *e'* *f'* *g'* *a'* &c.

(The keynotes are put within parentheses.)

So was it with the Greek lyre; as separate sections were taken out of scales which (like ours in that respect) were all completely of the same pattern, these separate sections, as in the illustration above, were of course very diverse in their tuning. And as the ancients sometimes refer to the octaves as played on the octave-lyre instead of the entire scales, great confusion has been caused and an entirely wrong notion has been given.

It now only remains to explain the *enharmonic* and the *chromatic* variations. What has been given above is the *diatonic* scale. Now in every tetrachord two variations existed. The chromatic variation consisted in tuning the second string of each tetrachord half a tone flat; the enharmonic variation required both the second and the third string to be altered, the third string being lowered a tone, *i.e.* to the pitch of the second, and the second lowered a quarter of a tone, midway between its old pitch and the first string of the tetrachord. Taking as an example the two middle tetrachords of the Hypo-Dorian *e f g a*, *b c' d' e'*, the *chromatic* variation would be *e f* $f\sharp$ *a*, *b c'* $c\sharp'$ *e'*, and the *enharmonic* variation would be e $\frac{1}{4}$ *f a*, *b* $\frac{1}{4}$ *c' e'*, where $\frac{1}{4}$ means a quarter of a tone above the previous note, a note midway between *e-f*, *b-c'* respectively.

The use of the enharmonic is evident. Nearly all ancient music is *pentatonic* (old Scotch tunes, many of the oldest English tunes, the entire Chinese repertory, &c.), for the notes we call the fourth and the seventh of the scale are much more difficult to sing than the others. (This is why so many old tunes can be played on the black notes of a pianoforte, with six notes to the octave, *i.e.* a five-sound or pentatonic scale.) But two strings were redundant in this tuning of the lyre, they therefore were turned into grace-notes, giving the little mordant or trill that a violinist calls a close shake—a favourite device with Oriental musicians, especially Arabs. Many of our concert singers use the same trick to give brilliancy to a prominent note. The quarter-tones, which used to seem so formidable in an account of Greek music, are simply grace-notes, therefore, when examined. The enharmonic was for a long time the favourite tuning.

The chromatic variety is still more valuable. For it will be found to combine a *pentatonic minor* and a *pentatonic major*. Its complete form in Hypo-Dorian (taking the two middle tetrachords only) was thus:—*e f* $f\sharp$ *a b c'* $c\sharp'$ *e'*. But out of this we get *e f a b c' e'* (minor), or as we should write it, keynote first, *a b c' e' f' a'*, and also the corresponding major *a b* $c\sharp'$ *e'* $f\sharp'$ *a'*. This succeeded the enharmonic variety in general favour. But finally, as musical skill and cultivation improved, the pure Diatonic was heartily adopted.

Certain modifications or colourings (*chroai*) of both enharmonic and chromatic existed, but need not here be noticed. For the notation of the Greeks see NOTATION OF MUSIC; and for an account of the discovery of the three pieces of ancient Greek music which have come down to us see GALILEI, VINCENZO. These are respectively hymns to Kalliope, to Apollo, and to Nemesis, and all are in Hypo-Lydian ($c\sharp'$ minor).

The old modes were very high in pitch (a fact leading many to believe that voices have become lower by civilisation); and late in the second century of our era Claudius Ptolemy, to whom we owe the disarrangement of our astronomy till Copernicus set it straight again, also disarranged Greek music by lowering the pitch of all the scales a fourth. Thus the Dorian *mesê* he put at *a* instead of *d'*, and so with all the rest. It relieved the voices, but it has caused much confusion.

The quite inaccurate revival, as it was thought to be, of the Greek musical system by the monks of the dark ages, who completed the cycle of errors by using the Greek names Dorian, Phrygian, &c., for scales constructed on a totally different plan, will be found explained in the article MODES, ECCLESIASTICAL.

GREEN EBONY is a dyewood extensively grown in South America. Its botanical name is *Jacaranda ovalifolia*, of the order BIGNONIACEÆ. It is a hard wood of an olive-green colour, and produces green, brown, and yellow dyes. It is generally imported in pieces about 3 feet in length, and is occasionally used for carpentry purposes and by turners. The tree has compound leaves, twice pinnate, and showy bluish flowers in terminal panicles. Green ebony is also the name given to the wood of *Excœcaria glandulosa*. See EXCŒCARIA.

GREEN CARBONATE OF COPPER is the name very often applied to the mineral MALACHITE, in contradistinction to the blue carbonate, AZURITE or chessylite.

GREEN'BACKS, the popular name for the paper currency of the United States, so called from the colour of the printing on the backs of the notes.

GREENE, MAURICE, MUS. DOC., the son of the vicar of St. Olave Jewry, London, was born at the end of the seventeenth century. He received his education in St. Paul's choir, under Brind, the organist, and in 1718 succeeded his master as organist in St. Paul's Cathedral. On the death of Dr. Croft, in 1727, he was appointed organist and composer to the Chapel Royal; and in 1736 was presented to the office of master of his majesty's band, on the decease of Eccles. The degree of Doctor in Music was conferred on him at Cambridge, his exercise being Pope's "Ode on St. Cecilia's Day," when he was elected professor of music, on the death of Dr. Tudway.

In 1750 Dr. Greene came into possession of a good estate in Essex, and died in 1755. Among his compositions are some charming cantatas and songs; but his fame is built on his "Forty Anthems for one, two, three, four, five, six, seven, and eight Voices," in two folio volumes, full of melody and vigour and at the same time in the highest degree scientific. Greene was very friendly with Handel, whose good graces he gained by inviting him to play at St. Paul's at a time when there were but few organs in London worth notice. At the same time he was intimate with Bononcini, who absurdly affected to be Handel's rival. Indeed it was Greene who innocently introduced the too famous madrigal of his friend, which when it was proved to be a shameless theft from Lotti caused Bononcini's ruin. The fine collection of cathedral music every one admires as the result of Dr. Boyce's care was in reality to a considerable extent made by Dr. Greene, who handed the whole valuable store over to Boyce when he could himself no longer work at it through infirmity, with a request that he would complete it.

GREENE, ROBERT, a remarkable dramatist and novelist of the Elizabethan period, was three years older than Shakspeare. He was born at Norwich in 1561, and went to St. John's College, Cambridge, where he met the poet Peele. After taking his degree in 1578 Greene went abroad and saw Italy and Spain. On his return he published some little love stories, and some translations. He married well in 1586, but in his remarkable confession prefixed to "A Groat's Worth of Wit bought with a Million

of Repentance," he narrates how he spent his wife's marriage portion with dramatists and actors in rioting and debauchery. His wife endeavoured to wean him from these evil courses, but he forsook her, and came to London. Brilliant stories, and curiously enough always on the right side in morality, now poured from Greene's pen. On one of them, "Pandosto," Shakspeare has founded his "Winter's Tale." At the same time he produced many plays, which had great success. His career was rather short. He died in 1592 in some distress. His last note, written to his wife, for whom he seemed always to retain respect, relates to a few pounds with which the charity of a poor cobbler had relieved him: "Doll, I charge thee, by the love of our youth and by my soul's rest, that thou wilt see this man paid; for if he and his wife had not succoured me I had died in the streets." Greene, worn out with riotous living, and wretched at the wreck of life which his undoubted genius and fine feeling showed him in all its misery, was driven almost to madness by the success of the plays of "a mere actor, a certain Shakspeare," who had come to London about six years before, and was steadily gaining money and fame, while he, a gentleman and a scholar, was in bitter poverty and had outlived his reputation. He bitterly says in the preface before alluded to, addressing Peele and Marlowe—"Unto none of you like me sought those burrs to cleave, those puppets I mean that speak from our mouths, those antics garnisht in our colours. There is an upstart crow beautified in our feathers that with his tiger's heart wrapped in a player's hide supposes he is as well able to bombast out a blank verse as the best of you; and being an absolute Johannes-factotum, is in his own conceit the only Shakescene in a country." The very bitterness shows the high note Shakspeare had already struck. Indeed he was "factotum" of all styles and for all time. The sentences are precious, among the very few authentic notices of Shakspeare we possess.

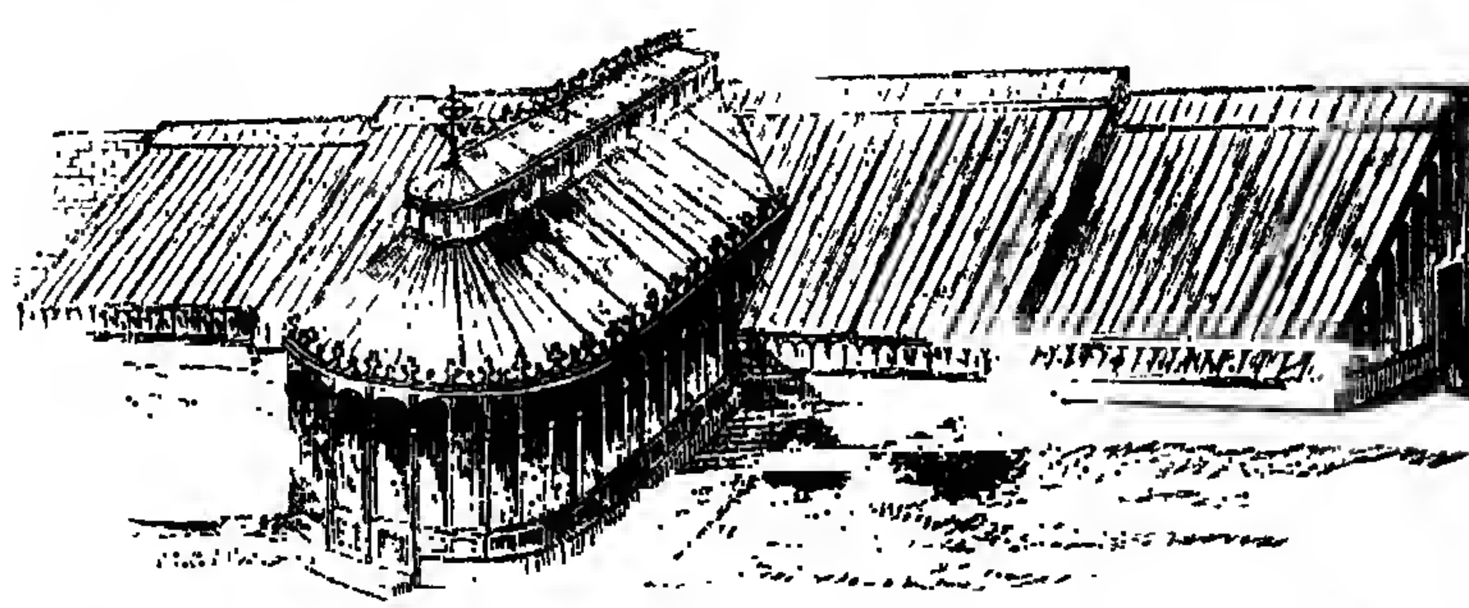
GREEN'FINCH, GREEN LINNET, or **GREEN BIRD** (*Coccothraustes chloris*) is one of the commonest of British birds, occurring also in most parts of Europe, and extending in Asia to the Pacific Ocean. The greenfinch is distinguished by the stoutness of its short conical bill. The general colour of the plumage is yellow or yellowish, becoming olive-green on the back; the wing primaries are grayish-black, with two-thirds of their outer edges bright yellow; the tail-feathers are grayish-brown, with the basal half of all, except the two middle ones, bright yellow. The female is of a pale brown colour, more or less tinged with yellow and green. The male is rather more than 6 inches in length; the female a little smaller.

The greenfinch haunts gardens, hedges, orchards, bushy places; it is rarer in the woods. Its food consists principally of the smaller seeds. Its nest is built in a hedge or bush, rarely in a tree, and is composed externally of roots, moss, and wool, lined with fine root-fibres, hair, and feathers. The eggs are four to six in number, white, with rusty-red speckles at the larger end. The song of the greenfinch is not disagreeable; but the bird is valued in confinement more for its extreme docility, and the pretty manner it has of showing its attachment, than for its vocal qualities, though it may be taught to repeat words. Hybrids between the greenfinch and the hen-canary occasionally occur in aviaries.

GREEN'GAGE is a favourite variety of the PLUM.

GREEN'HEART is the name of a valuable timber imported from British Guiana, and the produce of *Nectandra Rodiæi*. It is considered to be so well-adapted for shipbuilding that it is placed in Lloyd's first class of shipbuilding woods. It is very dense and therefore heavy. It is durable, resists the attacks of borers, and can be obtained in great lengths; but its weight sometimes counterbalances its other advantages. Its ash-coloured bark, called *bibiru* or *sipiri*, as well as the seeds contain an alkaloid which has somewhat the same properties as quinine, and is used in its native country for the same purposes. Nectandra belongs to the order LAURINEÆ.

GREEN'HOUSE, a building for growing and protecting those kinds of plants which are too tender to live in the open air. The earlier greenhouses were glazed only on the sides; glass roofs were introduced about the year 1700, and arched or curvilinear glass roofs during the present



century. The temperature must be regulated by the nature of the plants, and it may be obtained by the use of stoves, of hot air, or of hot-water pipes; or in the case of conservatories by surrounding the base with manure, which decomposing gives out the required warmth. As greenhouse plants do not require artificial heat in summer, the roof of the house is sometimes made removable at pleasure, or more generally the plants are carried out into the open garden. The chief use of the greenhouse is to protect the plants from frost, cold winds, and heavy rains, and to equalize the temperature all the year round.

In winter the plants should be kept rather dry, particularly if the weather be cold and frosty. Damp is very injurious to plants at that season of the year; and if ever any leaves are seen in a mouldy state, they should be instantly picked off and cleaned away, because they would soon infect others, and the whole plant would in a very short time be rendered useless. When a fire is lighted to keep out frost, the temperature should not exceed 45° Fahr.; and if there be no frost, and it is put on to dry off the damp, plenty of air must be given, otherwise the moisture will rise, condense upon the glass, and fall again when the house gets cool.

In summer plenty of air should always be given; and if the house have ventilators in the front and back, they may be left open during the night as well as the day. At this season water must be freely given twice every day, and the plants syringed overhead at least every morning. When the atmosphere is very dry a few pots of water should be thrown upon the passages, which will render it more moist,

lower the temperature, and prevent the plants from suffering from excessive heat. If plants are crowded together they always present an unsightly appearance, and can never grow into fine specimens; where the latter are wanted plenty of room is indispensable.

In the autumn, when the least sign of frost appears, plants must be instantly removed into the greenhouse. This will also be the most convenient time for cleaning, top-dressing, and shifting those which require it. A greenhouse, accurately speaking, differs from a conservatory in the plants being in pots and movable, instead of in the earth.

GREEN'LAND is an extensive country, the greater part of which belongs to Denmark, situated between Iceland and the continent of America. Its southern extremity, Cape Farewell, is situated in 59° 49′ N. lat., and 43° 54′ W. lon. The British Arctic expedition of 1876 traced the northern shores as far as Cape Britannia, in lat. 82° 54′. The German Arctic expedition of 1870 pursued the east coast as high as 77° N., so that between Koldeway's furthest in 1870 and Beaumont's furthest in 1876 there remains an interval of more than 500 miles of the Greenland coast yet unexplored. The estimated area of the whole country is about 340,000 square miles. The outline forming the sea-coast of Greenland is in general high, rugged, and barren; close to the water's edge it rises into tremendous precipices and lofty mountains, crowned with inaccessible cliffs, which may be seen from the sea at a distance of more than 60 miles.

The vast extent of Greenland, together with its peculiar position between Europe and America, secures for it a very special interest. From its most northern discovered point, Cape Britannia, it stretches southward, in a triangular form, for a distance of 1500 miles. Its interior is nearly a closed book to us, but the coast has been thoroughly explored and examined on the western side from Cape Farewell to Upernavik, a distance of about 800 miles, as well as along the western shores of the channels leading from Smith's Sound; and from Cape Farewell to the Danebrog Islands and Cape Bismarck on the east side. These belts of coast line consist of the most glorious mountain scenery—lofty peaks, profound ravines, long valleys, precipices and cliffs, vast glaciers, winding fiords often running 100 miles into the interior, and innumerable off-lying islands.

For our slight knowledge of the Greenland interior—a vast region which it has been found impossible to penetrate for any great distance—we are indebted to the brave Professor Nordenskiold, who in 1880 visited England on his way home from the discovery of the North-east Passage. This interior, exclusive of the inhabited coast line, with its deep fiords and lofty mountain ranges, covers an area of 320,000 square miles, the whole of which is buried beneath one mass of glacial ice, with numerous ice-streams reaching the coast and breaking off in the form of icebergs. The coast is here and there bordered by an ice-wall several hundred feet high, which cannot be scaled. One of the finest of these is the stupendous Humboldt Glacier, a gigantic cliff of ice 400 feet high, which borders upon Smith's Sound for a length of 40 miles.

Professor Nordenskiold could only penetrate over the inland ice for a distance of 30 miles from its edge, where he was 2200 feet above the sea, and the ice was still rising before him. Amund Helland, a Norwegian geologist, has also carefully investigated the action of the Greenland glaciers, and thrown much light upon their formation, rate of travel, &c. He found that the ice-streams moved from the interior towards the sea at the rate of 47 feet a day in the summer season, which is twenty times the velocity of glaciers in the temperate zone. The climate is severely cold. July is the only month when there is no snow: it stops in June, and recommences in August. The earth begins to thaw in June, but at no great depth ice is always found. The heat in the few but long summer days is so great as to evaporate the water left by the tide among the rocky clefts, and to leave a residue of beautiful fine salt. The vegetation is scanty. It is chiefly composed of mosses and lichens, and includes a small number of annual plants and a few shrubs, most of which bear edible berries. Sheep are kept, but the difficulty of procuring provender for the long winter limits them to a small number. The chief land animals are dogs, reindeer, hares, foxes, and white bears. Sea-fowl and fish are plentiful.

The oscillations which the coast has undergone, and is undergoing, are also remarkable. In Smith's Sound it is said, with some degree of probability, that the coast is rising, and the same fact has been observed throughout the whole extent of the circumpolar basin. But whether this is so or not there can be no doubt that south of 73° N. the coast is sinking. This depression has been observed ever since the Danes came into the country, but the period when it commenced can never be ascertained. The low tracts along the coast and the fiords only are inhabited. The inhabitants consist of natives and Danish settlers, the latter amounting to between 200 and 300. The natives are Eskimo, and are allied to the Mongolian family, of short squat stature and dark skin; they are employed chiefly in fishing and seal-hunting. The number of those who have intercourse with Europeans is estimated at nearly 10,000.

Greenland was discovered in 981 or 983 by an Icelander or Norwegian named Gunbiörn, and was soon afterwards colonized by a number of families from Iceland, of whom all historical traces soon disappeared; they appear to have formed their settlement on the western coast. The country was called Greenland because its southern extremity was first seen in spring-time, and presented a pleasing appearance, but it was speedily found to be little better than an icebound region. Davis rediscovered Greenland in his voyage, 1585–87; and in the beginning of the seventeenth century the Dutch government fitted out several expeditions to re-establish a communication with the lost colony. In 1721 Hans Egede, a Norwegian pastor, planted a colony at Godthaab (near 64° N. lat.) for the purpose of converting the natives to Christianity. From the year 1733 he was assisted by the Moravian Brothers. After the foundation of the colony a regular commerce with the natives was established, which led to the erection of other settlements, and there are now altogether thirteen —six in the south and seven in the north—besides two missionary stations. The Danes obtain from these settlements sealskins, fur, eider-down, train-oil, whalebone, and fish.

The commerce of Greenland with Denmark is carried on with about sixteen vessels, the property of the Royal Greenland Fishing and Trading Company, by whom the colony is administered. The company received its charter in the year 1781, and enjoys a monopoly of the trade and privileges very similar to that once held by the Hudson Bay Company. The country is divided into north and south inspectorates, separated by the Long Fiord, in lat. 67° N. The principal settlements are Frederick's Harbour, Julian's Harbour, and Good Hope. Copper ore is found, and the new mineral kryoleth, which abounds in sodium.

GREEN'LET is the name given to a small family of birds, Vireonidæ, peculiar to America, from the prevalence of green or olive tints in their plumage. The greenlets were formerly classed with the flycatchers (Muscicapidæ), but now form a separate family. Their nearest allies seem to be the shrikes (Laniidæ). The bill is short and straight, notched in both mandibles. They are all of small size.

The White-eyed Greenlet (*Vireo noveboracensis*) is a common summer bird in the United States of America, where it arrives somewhat early in the year from its winter haunts in the West Indies and tropical America. It is rather more than 5 inches in length; the plumage of the

upper parts is yellowish-olive, of the lower surface white, with the sides of the breast yellow; round each eye is a yellow line, and near each nostril is a spot of the same colour. It is an active, lively, and sociable little bird, possessing a strong voice and a song of considerable variety. It builds a neat nest in the form of an inverted cone, suspended by the upper edge; the materials of which the nest is composed are fragments of rotten wood, dry stalks, and similar articles; it uses so much old newspaper in the construction of its nest that it has received the name of the Politician. The materials of the nest are held together with the silk of some caterpillars, and the lining consists of fine dry grass and hair.

The Red-eyed Greenlet (*Vireo olivaceus*) is also a summer visitor to the United States, while its winter is passed in warmer latitudes; it is a well-known bird in Jamaica, where it is called "Whip Tom Kelly," from a fancied resemblance in its song to those words. Wilson says that by listening attentively for some time to the note of this bird, it requires little imagination to fancy that it pronounces the words "Tom Kelly, whip Tom Kelly," very distinctly; but Mr. Gosse dissents from the general opinion, and says that the notes resemble the syllables "John-to-whit," the last syllable pronounced with emphasis. The Whip Tom Kelly is a little larger than the preceding species; its general colour above is yellowish-olive, beneath white; a white line runs from the nostril over the eye, which has a red iris. It feeds on seeds, berries, and insects. The nest of this species is likewise conical in form, and paper is one of its constant materials. The nest is placed in bushes or dwarf trees; the eggs are three in number, with a few small reddish-brown spots. Both these species are frequently selected by the cow-bird as foster parents to its offspring.

GREEN'OCK, a parliamentary burgh, market-town, and seaport, and one of the largest towns of Scotland, is situated on the southern bank of the Frith of Clyde, in the lower ward of Renfrewshire, 22½ miles from Glasgow and 68 miles from Edinburgh. It extends upwards of 4 miles along the shore, and the hills which form the background rapidly attain an elevation of 800 feet. The town has a very extensive commerce, and in 1881 the population was 63,903. For the accommodation of the shipping much has recently been done to improve the harbour, and a magnificent wall has been constructed, which affords harbour room equal to 53 acres with an average depth of 25 feet at low water. Alongside Princes Pier there is a depth of 16 feet at low water, and there are admirable facilities for berthing ships in the Albert, Victoria, West, Mid, and East India Harbours. The Garvel Graving Dock has 20 feet of water on the sill at spring tides, and is 650 feet long, with an entrance 60 feet wide; while the James Watt Dock has 32 feet depth at low water, is 2000 feet long, and 75 feet broad at the entrance. The Glasgow and South-western Railway and the Caledonian Railway have access to all the harbours, connecting the town with the Ayrshire coal mines, and providing independent connection with England and the south-western counties. Early in 1884 a bill passed Parliament for the extension of the Caledonian system to Gourock, a fashionable watering-place about 3 miles to the west of the town. The undertaking is expected to be completed and traffic opened in 1886. The number of vessels registered as belonging to the port in 1884 was 420 (215,000 tons). The entries average 7500 (1,450,000 tons), and the clearances 5000 (820,000 tons) per annum. The customs revenue in 1883 was £89,000. On the discontinuance of Port-Glasgow as a customs port in 1875, most of the official business of that place was transferred to Greenock. There are numerous large sugar refineries, distilleries, paper, cotton, worsted, and jute mills, many rope and sail factories, and several large shipbuilding and engineering establishments. The town is also the principal seat of the West Indian sugar and North American timber trades. The principal buildings are the exchange, custom-house, county buildings, library, and Watt Museum, old town-hall, designed by James Watt, who was a native of the town; several banks, post-office, mariners' asylum, sailors' home, and large modern town buildings and court-house, fish market, many churches, chapels, and schools, a club, a poorhouse and asylum, and an hospital. The cemetery is one of the finest in Great Britain. Two public parks have been presented to the town by Sir Michael Shaw Stewart, Bart. There is also a public park on the summit of the Whin Hill. A magnificent esplanade stretches a mile west from Princes Pier, and is terminated by the boathouse of the West of Scotland Yachting Club and Fort Matilda, the latter armed with four guns. Immediately behind Fort Matilda rises the Crags or Lyle Hill, in precipitous ascent to the height of 600 feet. From its top a splendid view of the whole valley of the Clyde can be obtained, and portions of nine different counties seen with the naked eye. A scheme is at present being matured to fortify this height with batteries for the protection of the Frith of Clyde.

The water supply is unsurpassed in the kingdom, and is stored in natural and artificial reservoirs situated among the hills immediately behind the town. The principal of these is Loch Thom, a triumph of engineering skill, from which the water is led by a circuitous conduit, or "cut," as it is locally termed, round the natural configuration of the hills, at a height of 600 feet above the level of the sea, from which it is conveyed into the town and manufactories, many of which are worked with water power.

Greenock was created a burgh of barony in 1635, and a parliamentary burgh in 1832. The parliamentary constituency, which returns one member to the House of Commons, consists of about 7400 electors. The burgh is governed by a provost, six bailies, a treasurer, and seventeen councillors. Among its commercial institutions are a chamber of commerce and a West India sugar exchange.

GOUROCK, a fashionable watering-place on the Clyde, 3 miles west from Greenock. Gourock Bay is favourably situated as a rendezvous for yachts, and during the winter innumerable craft of this description are harboured there.

GREEN'OCKITE is the sulphide of cadmium (CdS), of an orange-yellow, honey, or citron colour, and nearly transparent. It crystallizes in the hexagonal system, with hemimorphism strongly marked, and has a hardness of about 3, with a specific gravity of nearly 5. It received its name from its discoverer, Lord Greenock, and was first noticed at Bishopton, in Renfrewshire, Scotland. This mineral, which is isomorphous with sulphide of zinc (BLENDE), is present in small quantities in many zinc blendes; from these most of the cadmium of commerce is extracted.

GREEN'SAND is the name applied to some of the CRETACEOUS series that have a predominant green colour imparted to them by GLAUCONITE. There are two main divisions, separated by the GAULT: the UPPER GREENSAND in the Upper Cretaceous or Cenomonian, and the Lower Greensand at the top of the Lower Cretaceous or NEOCOMIAN.

GREEN'SHANK (*Totanus glottis*) is a bird chiefly seen in Britain in the spring and autumn on its journey to and from the high northern latitudes in which it breeds; some few, however, breed on the edges of the Scotch lakes. The greenshank is of an ashy-brown colour above, with the edges of most of the feathers buffy-white; the primaries are black and the tail white, barred or striped with brown; and the lower surface is white, with the neck and breast, and the sides under the wings, marked with ash-coloured streaks. The bill is black and the feet olive-green. This bird occurs in Europe, Asia, and North America, and generally in the vicinity of the coasts. The greenshank belongs to the SCOLOPACIDÆ, a family of wading birds.

GREEN'SLATES and **POR'PHYRIES** is a term applied to the volcanic series of tufas and lavas of the Cambro-Silurian age, that occur in Cumberland; they are about 12,000 feet thick, and are probably equivalent to the Llandeilo, Caradoc, and part of the Bala beds, but they are mostly unfossiliferous and without ordinary sedimentary strata.

GREEN'STONE is a term in geology that has been applied to a number of basic igneous rocks, of variable composition, but possessing as a rule a greenish colour, as BASALT, GABBRO, DIABASE, DIORITE, &c. Though not a precise term, it may be conveniently retained for basic rocks with a fine granitic structure, to designate them in the field, till their exact mineralogical constitution can be ascertained. In this ambiguous sense the term includes a number of intrusive and eruptive rocks that occur in dykes, bosses, and vast sheets.

GREEN'WEED is another name for dyer's broom. See GENISTA.

GREEN'WICH (pron. *Grin'ich*), a parliamentary borough of England, in the county of Kent, situated on the south bank of the Thames, $3\frac{1}{2}$ miles from London by the South-eastern Railway. Greenwich Park, which comprises nearly 200 acres, is well planted with elms and chestnut trees. It was laid out from the designs of the celebrated John Evelyn, and spreads between the hospital and Blackheath. It was first inclosed by Duke Humphrey of Gloucester, protector in the reign of Henry VI., and still has numerous herds of deer and some fine old trees. Upon one of its eminences, 160 feet above the river, is situated the Royal Observatory, commonly called Flamsteed House, the residence of the astronomer-royal, and it is from the meridian of this observatory that the longitudes are computed on all British maps. The chief object of interest in the town is the hospital, formerly used for aged and disabled seamen. [See GREENWICH HOSPITAL.] There are several churches and chapels, and also large proprietary and primary schools. In 1876 some public offices of considerable architectural pretension were erected. The main feature of the exterior is a central clock-tower, with dome and lantern. At Greenwich is the pumping station of the South Metropolitan Main Drainage Works. Although chiefly a pleasure town, the manufacturing establishments are extensive and growing in importance. Among them are several noted engineering works (Penn's, Maudsley's, Rennie's, &c.), iron-foundries, shipbuilding yards, celebrated telegraph cable works, india-rubber and kamptulicon works, breweries, &c. In the parish church of St. Alphego lie the remains of General Wolfe and the celebrated Lavinia Fenton, duchess of Bolton. Among the other public edifices of Greenwich are the Trinity Hospital, founded by the Earl of Northampton in 1613, for twenty-two pensioners. Greenwich was a royal residence from the year 1300 to the reign of William and Mary. Henry VIII. was born and baptized here, and here he married Anne of Cleves. It was also the birthplace of Queen Mary and Elizabeth, and Edward VI. died in its old palace. Population of the parish, 46,580. The Reform and Redistribution Acts of 1884–85 made Greenwich a distinct parliamentary borough returning one member. The population of the borough is 65,411, and the number of electors on the roll 8632. The borough formerly included Deptford.

GREENWICH HOSPITAL, formerly a home for naval pensioners, on the south bank of the Thames, 5 miles below London Bridge. It was once a royal palace, and was converted into its hospital use by William and Mary in 1694. The building is a series of patchwork, in various styles, having been designed by several architects, including Inigo Jones and Christopher Wren; it is nevertheless very imposing as seen from the river. The hall or gallery and the chapel are magnificently decorated, and the rest of the interior is remarkable for extreme neatness and order.

The hospital was founded for maintaining, lodging, and clothing 800 maimed seamen. The royal founders were assisted by private contributions to the extent of £60,000, and when in 1715 the Earl of Derwentwater was attainted of high treason, his estates were appropriated to the hospital, and brought in £6000 per annum. But so largely has their value increased by the discovery of mineral veins underneath, that they now yield a gross rental of more than £50,000 a year, the whole of which belongs to the hospital. There are also estates in the town of Greenwich bringing in a few thousands per annum. From time to time the hospital was awarded forfeited and unclaimed naval bounty and prize-money, deserters' prize-money, a percentage on *all* bounty and prize-money, a percentage on admiralty droits, and a percentage on the freightage earned by carrying treasure in royal ships. It also received a small portion of the fines levied against smugglers, the effects of the famous Captain Kydd the pirate, portions of the coal and culm tax, Robert Osbaldeston's bequest of £20,000, and smaller bequests from other persons. For a period of 130 years sixpence per month was also contributed to its support by every seaman in the royal navy, and for a still longer period the same amount was paid by every merchant seaman; but in 1834 these amounts were commuted for a government grant of £20,000 a year, reduced in 1869 to £16,000. From all these sources, the property of Greenwich Hospital is now so large (amounting to £3,512,000), that the mere interest on the amount, added to the rental of the Derwentwater estates, makes up the noble sum of £200,000 per annum. The government of the hospital, until October, 1865, was vested in five commissioners appointed by the crown, two of whom were the paymaster-general and the first commissioner of public works. These two received no pay, but the others had each £600 a year. The seamen eligible for admission were those who, from wounds received in the service of the crown, age, imbecility, or disease, had become incapable of maintaining themselves. The pensioners were lodged, clothed, fed, and had a weekly allowance of— petty officers, 5*s.*; seamen who had had pensions of more than £15 a year, 4*s.*; and those whose pensions had been less than that sum, 3*s.* An additional 2*s.* per week was granted to married pensioners to aid them in supporting their wives, also to widowers with children. There were generally about 1600 inmates. They all relinquished their ordinary pensions on entering the hospital. The out-pensioners received on an average £17 per annum each, in addition to their regular pensions. There were also ten captains, fifteen commanders, fifty lieutenants, and fifteen masters on the out-pension list. The in-door staff consisted of a governor, lieutenant-governor, four captains, four commanders, eight lieutenants, two masters, two chaplains, medical officers, and nurses.

For many years it was a question whether this grand establishment, with its large endowments, its costly buildings, and its expensive administration (in 1859 the establishment charges were £48,000!) tended to promote the objects for which it was originally founded; and in 1865 an Act was passed by which the management of the hospital and its funds became entirely changed. The offices of commissioners, governor, and lieutenant-governor were abolished, and the whole management of the establishment vested exclusively in the admiralty. The expenditure is now included in the navy estimates, and defrayed in the first instance from the consolidated fund, but, of course, repaid from the hospital account; and both the income and expenditure are annually subjected to the review of Parliament, though the former is not merged in the general property of the nation. Under the Act of 1865 every inducement was offered to the inmates to leave the building and become out-pensioners, with the prospect of a maximum annual payment of £36 10*s.*, or 14*s.* per week.

Out of 1400 then in the hospital 1000 at once accepted the offer, and only thirty of them ever applied for readmission. The benefit of the change on the health of the men soon became apparent, for the annual death-rate was reduced from 12 to 6 per cent. in two or three years. With the view of carrying this beneficial state of things still further, another Act was passed in 1869, by which the number of in-pensioners was again very considerably reduced, the few who remained being placed in the infirmary, a large building totally distinct from the hospital. Admission to this infirmary is now only open to helpless and infirm naval pensioners who have been granted a life pension, or to any helpless and infirm seaman or marine who has served with good character ten years, or to any man discharged from the service on account of severe wounds or hurts received in action or in the execution of his duty. Every such applicant, when his claim is allowed, is offered the alternative of entering the infirmary or of residing with his friends and receiving such a sum as will make up his aggregate pension to an amount not exceeding 1*s.* 6*d.* a day, or £27 10*s.* a year, and under these circumstances the admissions are exceedingly rare.

When the pensioners were being induced to leave the hospital, it was objected that a large number of seamen of the royal navy were at the same time in the workhouses of the United Kingdom, and that it would have been better for the national honour to have provided for them comfortably in the hospital. Nearly the whole of these men, however, belonged to the class of permanently invalided seamen who had been discharged from hospital, but had not served sufficient time to entitle them to any pension. So well, however, have the funds of the hospital been managed, and to such an extent has the sum spent in "establishment charges" been reduced, that all these men have, since the Act of 1869, had the alternative of entering Haslar or Plymouth hospitals, or of receiving a pension of 1*s.* 6*d.* per day as an out-pensioner. The public now have the assurance that no man who has long served his country at sea, or has been invalided from the service, need become an inmate of the workhouse.

For some time after the in-pensioners were provided for, the noble pile of buildings remained comparatively deserted. The government at last resolved that it should be utilized for educational purposes, and the building was converted into a royal college for naval cadets, which was opened in 1873. In this one grand naval college are now grouped kindred establishments, such as the school of naval architecture, which formerly lay dispersed at Kensington, Portsmouth, and other places. In the new college the purpose is to supply a sound and varied education for the whole body of junior officers, giving to such of them as have the taste for mathematics opportunities for its systematic study, and to others with a turn for practical mechanics, or chemistry, or languages, or naval architecture, the means of applying themselves under skilled teaching, and with the aid of workshops and museums, to the pursuit of those branches of learning in which they are likely to excel.

At the rear of the hospital are schools called the Greenwich Hospital Schools, for the gratuitous education of a large number of boys, sons of petty officers, seamen, and marines. The school is managed by the same authorities as the hospital, and the funds are drawn from the same source.

By the judicious investment and sale of hospital funds and property, the revenue shows a decided tendency to increase year after year, and the benefits of the trust are extended in fair proportion. The number of boys in the school has been increased from 800 to 1000; the larger out-pensions have been made payable at the age of sixty-five instead of seventy, and gratuities have been authorized to the widows, orphan children, or aged parents of seamen and marines slain or drowned in the service of the crown. Under the old *regime* there were 1400 pensioners, whereas 6000 seamen now receive out-pensions, augmenting according to age, and in addition to pensions they may draw from the state. The school, with its largely augmented number of pupils, has been reconstituted, is now a regular feeder for the royal navy, and the yearly expenditure upon it has been increased from £20,000 to £82,000.

GREENWICH OBSERVATORY. The institution of the Royal Observatory at Greenwich originated in the following circumstance:—The extension of navigation in the sixteenth and seventeenth centuries made it a matter of great importance to possess the means of accurately determining the longitude of a ship at sea. It was remarked that this could be effected, provided that the motion of the moon among the stars could be exactly predicted before a ship left England. A plan founded on this principle was proposed by a Frenchman named Le Sieur de St. Pierre to Charles II. in 1674, who referred it to a commission of official and scientific men, by one of whom (Sir Jonas Moor) the opinion of Flamsteed (who was well known as a very learned and enthusiastic astronomer) was taken. Flamsteed, however, stated that the lunar tables were far too much in error to make this method practicable, and that even the places of the stars in existing catalogues, which must be the foundation for every theory of the motions of the moon or planets, were grievously faulty. Accordingly the Royal Observatory at Greenwich was established in the year 1675. Flamsteed was appointed astronomer-royal, with a salary of £100 a year. In the warrant of Charles II. for the payment of his salary he is styled our "astronomical observator;" and he is directed "forthwith to apply himself with the most exact care and diligence to the rectifying the tables of the motions of the heavens and the places of the fixed stars, so as to find out the so much desired longitude of places, for the perfecting the art of navigation." Flamsteed held the post till his death in 1719. His observations are collected in an important work, entitled "Historia Cœlestis Britannica," published in three volumes folio, the third containing a catalogue of 2935 stars, reduced to the beginning of the year 1689.

The second director of the Greenwich Observatory was the celebrated Dr. Edmund Halley. His labours were chiefly confined to observations of the moon, the result being inserted at the end of his planetary tables, published in 1749. He died on the 14th of January, 1742, and was succeeded by Bradley, who had already become illustrious by his discovery of the aberration of light. In 1749, the observatory having been furnished with a brass quadrant of 8 feet radius, Bradley commenced a series of observations with the new instrument, which he continued to prosecute till his death in 1762. Bradley is universally regarded as one of the greatest observers of ancient or modern times. It was during his career as astronomer-royal that he made the series of observations which resulted in his great discovery of the nutation of the earth's axis. The successor of Bradley was Dr. Bliss, Savilian professor of geometry in the University of Oxford, who died in 1765. The next astronomer-royal was Dr. Maskelyne. His observations embraced the determination of the sun, moon, and planets, and a select number of stars; and he continued to adhere to this plan throughout his long career. Maskelyne first introduced the practice of observing the transit of a star at five vertical wires of the telescope. He was also the first who noted the transit of a star in terms of tenths of a second. He died in 1811. He was succeeded by Pond, who had already distinguished himself as a practical astronomer. He commenced a series of observations with a mural circle of 6 feet diameter. In 1830 he published a catalogue of 1112 stars, which proved of great value to the practical astronomer. He retired from office in 1835, and died the following year.

Pond was succeeded by Mr. (afterwards Sir) G. B. Airy,

who held the office forty-seven years, having been succeeded in 1882 by the present astronomer-royal, Mr. W. H. M. Christie. Mr. Airy had been previously Plumian professor of astronomy in the University of Cambridge, and also director of the Cambridge Observatory from 1828. While engaged in the latter capacity he set the example of reducing all his observations as soon as they were made—a practice which has since been adopted at all public observatories. Upon his recommendation the lords of the admiralty defrayed the expenses of reducing all the observations of the moon and planets made at Greenwich from 1750 to 1830. Great improvements were effected in the instruments of the observatory during Mr. Airy's directorship. In 1847 an altitude and azimuth circle of peculiar construction was erected, for the special purpose of making observations of the moon out of the meridian. In 1851 the great transit circle was erected; the length of the telescope is 12 feet, the clear aperture of the object glass 8 inches, and the length of the axis between the pivots 6 feet. In 1852 the reflex zenith table was put up, for making observations near the zenith and determining the value of aberration. In 1859 observations were commenced with a magnificent equatorially-mounted refractor of 12 inches clear aperture and a focal length of 16½ feet. The observatory at Greenwich was the first to employ galvanic signals on an extensive scale in the transmission of time. By this means, since the year 1852, a time-ball has been dropped on the dome of the observatory, and also at several public and private establishments in London, at precisely twelve o'clock. By means of the telegraph wires, also, the longitude of the other principal observatories throughout the kingdom has been accurately determined. A volume of observations is published every year, under the superintendence of the astronomer-royal. The cost of the establishment is about £7000 annually—the estimate for the year 1884–85 having been £6951. The astronomer-royal receives £1200, his seven assistants sums varying from £200 to £600 each, and the contingent expenses amount to over £2000.

A subject important to navigation, though but slightly connected with astronomy, became ingrafted on the regular business of the observatory. In 1822 chronometer-makers were allowed to send a certain number of chronometers each in competition for prizes, to be adjudged after a year's trial; and above sixty chronometers have sometimes been on trial at once, requiring to be carefully rated every day. A similar competition was repeated every year. This system was abandoned in 1836. Chronometers having been universally introduced into the royal navy, the Royal Observatory is made the depot for them, and while there they are regularly rated.

From the preceding statement it is hoped that the reader may be able to form some idea of the nature of the astronomical business to which the Royal Observatory at Greenwich is devoted. It is not to the gazing at planets or nebulæ, or to the watching the appearances of the spots in the sun or the mountains in the moon, with which the dilettante astronomer is so much charmed; it is not to the measures of the relative positions and distances of double stars, or the registering of the present state of the nebulous bodies which appear liable to change—measures and registers of great importance, but which possess a charm sufficient to persuade private observers to undertake the observations, and which do not demand extreme nicety of adjustment of the instruments, nor require much calculation afterwards; but it is to the regular observations of the sun, moon, planets, and stars (selected according to a previously arranged system). From these are deduced the positions of the various objects with an accuracy that can be obtained in no other way; and they then can be used as bases to which observations by amateur astronomers, with different instruments, can be referred. See GRAVITATION.

In consequence of the continuity, the regularity, and the general excellence of the Greenwich observations of the sun and moon, they have been almost exclusively used in the construction of the theory and tables of the motions of those bodies. Indeed, up to the year 1814 there are no observations, even detached ones, at other observatories which can be put in competition with the corresponding ones at Greenwich.

GREGARI'NA is the typical genus of a small group of internal parasites forming a class, Gregarinida, of the PROTOZOA. The Gregarinæ are unicellular animals provided with a nucleus, but without pseudopodia. The Gregarina (*Monocystis lumbrici*) found in the reproductive organs of the earthworm is of an elongated oval shape, and consists of granular protoplasm surrounded by a cortical layer, which is apparently retractile, and inclosed in a firm membrane. This parasite is very minute, being only about one-eightieth of an inch in length. Reproduction usually takes place by a process of conjugation. Two individuals come together, and a horny globular cyst forms round them. The nucleus of each cell disappears, and the two Gregarinæ completely fuse: eventually the whole protoplasm breaks up into spores. These spores or *pseudo-naviculæ* are boat-shaped bodies with a thick external case. By staining and using a high power of the microscope the protoplasm of each pseudo-navicula is seen to consist of several little sickle-shaped bodies. These are liberated when the pseudo-navicula, having escaped from the cyst, bursts: they become by direct growth adult Gregarinæ. In insects and crustaceans, especially lobsters, elongated Gregarinæ are found apparently two-celled; they are, however, truly unicellular. The granular medullary substance which we have seen in the Gregarina of the earthworm is here separated by the cortical substance into two parts. One extremity is often provided with hooks, by which the parasite attaches itself to the tissues of the host. The cell-wall is often longitudinally striated. Some of these Gregarinæ attain a length of half an inch.

GREGORIAN CALENDAR. See CALENDAR.

GREGORIAN MUSIC is the title given in a general way to what is more accurately termed *Plain Song*, since though in every language it has both titles, and though in nearly all the title of this article is the favourite one, there is not the least doubt that St. Gregory the Great had very little to do with it as we now know it. It is the ancient music of the Roman Catholic Church, much of it so old as to be lost in the darkness of time, and but very little of it definitely assignable to any given person. Rousseau roundly alleged that the oldest portions were derived from the ancient Greeks, an opinion held before his time, and also very frequently since. Others, in considerable number, but with less probability, claim a Hebrew origin for them, asserting that in the most ancient *tones* we have the Temple melodies preserved. Antiquaries still labour the point as diligently as ever, but seeing that the whole body of music depends upon oral tradition, in the first instance, it looks improbable that the real origin of plain song will ever now be found.

The received tradition, which will not hold under critical inquiry, is that St. Silvester first began the collection of church music by founding a school at Rome for its study, under the patronage of Constantine, about the year 314. Probably much that was held sacred was thus intentionally preserved in a pure tradition; and we know that an earnest movement existed against any new music being admitted, a narrow view stoutly combated by St. Chrysostom among others. Later than Pope Silvester was St. AMBROSE, bishop of Milan (339–397), to whom, according to tradition, we owe the Te Deum. He not only did over again the work of Silvester, and confirmed and strengthened the knowledge of the sacred melodies, but he arranged them in four modes or scales, the so-called *authentic modes*

[see MODES, ECCLESIASTICAL], and introduced antiphonal singing, or the alternate singing of two choirs. The fame of this Ambrosian collection was very great, and oral though it probably was it lasted nearly 200 years. But by the time of St. Gregory the Great, who ascended the papal throne in 590, the ancient melodies were growing dim, new tunes had sprung up not singable in Ambrose's four scales, and a more authoritative collection was imperatively necessary. This was made, as we know for a fact, by Gregory himself and those who worked with him. It is also asserted that four more scales, the *plagal scales* [see MODES, ECCLESIASTICAL] were invented, so that the tunes which had extended beyond the limits of the Ambrosian rules might be expressed, and that the whole was written down in the *neumes* or signs which formed the notation of the time. There seems fair ground for believing that Ambrose's ritual was largely rhythmical, but that Gregory introduced the measureless, unaccented, *timeless* delivery which is so remarkable a peculiarity of Gregorians to this day, or if he did not introduce it he found it grown up to his hand and adopted it. He settled, so tradition says, the main features of the mass so far as chanting is concerned. All this Gregory put into an *Antiphonary*, so vast an improvement upon anything ever done before that it spread over the whole Catholic world. The good pope himself sent it, with trained singers to explain it, into his favoured England in 604, eight years after St. Augustine had founded the church of Canterbury. In 660 Pope Vitalian did the same for Brittany. In the next century we find Pippin of France sending to Rome for renewed teaching of Gregory's Antiphonary, and Charles the Great, when at Rome in 790, himself enlisted Pope Adrian's sympathies for the Frank Empire. He took away with him twelve singers and an autograph copy of the famous book. It is fondly believed by many antiquaries that the ancient Antiphonary at the Monastery of St. Gall, in Switzerland, is a copy of this date of Gregory's work. Charles erected many music schools, and we learn from Eginhard that he would even brandish his staff at delinquents who strayed from the true tradition he loved.

But we now come to historical times, and the famous bull of Pope John XXII. (*Docta sanctorum*), issued in 1322, "against the major third," as it has been wittily said, bears witness to the vain endeavour to keep the now rapidly rising tide of harmony from the church. Matters grew seriously bad at last. Our own Wolsey had thoughts of interfering with the many "uses" of England, and abroad, notably in Italy, it was not uncommon to accompany the sacred tones of the mass with counterpoints based on the favourite tunes of the day. The melodies themselves were so variously sung as to be almost distinct in different churches. Therefore Palestrina was set to revise the whole now immense body of Gregorian music in 1576, much as if one should use a razor to chop wood. He did not live to finish the great and difficult piece of drudgery, but he left the huge mass sorted and purified so that it could swiftly be brought into order. Since then it has not varied. In England we have an interesting survival of Gregorian music in the famous adaptation of the Gregorian melodies to the English ritual of the early reformation, by John Marbeck in his famous "Booke of Common Praier, noted" (1550); a piece of work so finely done as to be as good as original, and to have lasted unequalled and undisturbed to our own day. It may be heard every day in our cathedrals except to the Psalms, and even there also in some choirs. The splendid Plantin edition was issued by the famous Antwerp house in 1599, and the still finer Medicean edition appeared at Rome in 1615. Of modern editions there are several. Up till late years the copies of the Medici version issued at Mechlin in 1848 were the best; but everything is now superseded by the exquisitely careful Ratisbon series of Pustet, published with the direct authority of Rome, the "Gradual" in 1871, the "Vesperal" in 1875, and so on.

The bulk of Gregorian music falls into well-defined masses readily enough. The first and most characteristic body, as well as the most ancient, are of course the famous *Gregorian tones*, or Gregorian chants, to which the Psalms are chanted in Roman Catholic and in many English churches, and which are described in the article TONES. Some of these are with fair probability assigned to the tradition of St. Ambrose, but the usual belief is that they were already ancient in his day. Later than these, but still of great antiquity, are the *Antiphons*, short passages of Scripture selected for every day in the year, and each of them with its proper plain-song melody. Every Psalm must be preceded by an Antiphon; the mode or key of the Antiphon prescribes, therefore, the tone (or chant) for the succeeding Psalm, because there is only one tone to each mode. Of less importance are the *Versicles*, the *Responses*, the *Accents* (marking the various stops as the reader intones the lessons for the day, the heads of chapters, &c., and varying for the epistle, the gospel, &c.), and other smaller but equally rigidly regulated parts of the service. In the article GRADUAL a fourth large division of plain song, as used in the Roman Catholic mass, is described in the two subdivisions of the ordinary (unchanged) and the special (changing) music of the mass. Of these the Ordinary (*Ordinarium*) is that part which in high masses is not sung to the plain-song melodies, but is set to music by the composers of the day. When we speak of Mozart's masses, &c., we speak of the sentences of the *Ordinarium* as set to the magnificent strains of that composer. Nevertheless the Kyrie, Gloria, Sanctus, Credo, Benedictus, and Agnus Dei have all their proper Gregorian melodies, and that in considerable variety. The great Ratisbon Gradual gives even ten of them.

The peculiar C and F clefs, the stave of four lines, and the square-headed notes now used for Gregorian music, and frequently called the *Gregorian Notation*, are of course comparatively modern, and have nothing to do with St. Gregory—"not invented till nearly 600 years after Gregory's death, and then not used for plain song for another 200 years," as it is pithily put by Hullah ("Modern Music").

Thus there is a large body of truly sacred music available for the church of very great antiquity, and of a tradition which, though not undoubted, is yet after much labour admittedly of tolerable purity. What wonder, then, that enthusiasts who think with gratitude that their ears drink in the very sounds which Augustine heard with joy [see AMBROSE, ST.], which threw St. Francis into ecstasy, and with which many a martyr and many a saint have sung themselves to rest, demand that this music, sanctified by, let us say, nearly twenty centuries of holy thoughts, should be the music, and the only music, of the church? Further, they ask also that, since the material of music was devoid of such and such notes and chords in the centuries when the Gregorian music was written, it shall not be now accompanied by them. In a word, they demand that musically we men of the nineteenth century shall, if we belong to the Anglican or the Roman Catholic Church, think and feel as the men of the first century did, a sheer impossibility. Nevertheless, he must be indeed dull of perception who is not strangely moved by this solemn music of the long-gone past which enshrines the antique Latin mediæval text; and while he who does not inherit its traditions with his birth will probably refuse to pretend to clothe his highest aspirations with its foreign tongue, yet he who finds in it the thoughts of his fathers would feel it sacrilegious to disturb it.

The best works for those who seek to use Gregorian music in the Anglican Church are the "Psalter, noted," and the "Brief Directory of Plain Song" (1850), and the "Hymnal, noted" (1851), of the Rev. Thomas Helmore.

GREGORY was the pontifical name of no less than sixteen popes.

GREGORY I. (*Saint Gregory the Great*) was born of senatorial rank in Rome about 540, distinguished himself for his learning, and was made prætor of that city in 573. He afterwards retired to a monastery (one of seven which he spent his whole fortune in building), having become disgusted with the world and determined to abandon it for a life of religious asceticism. Here he soon became abbot, but it was before this, while he was yet a simple monk, that the memorable incident which endears him to Englishmen occurred. As Bede tells it, Gregory saw some young slaves for sale in the market. "Who are they?" asked he. "Angles," it was said. "Not Angles but Angels," replied Gregory, for their fair skins were very beautiful. "What part of Anglia do they come from?" was his next question. "From Deira." Then said Gregory, "That is true, and heathen though they be I will help to redeem them from the wrath (*de irâ*) of God." Nothing but the stern command of his superiors, who meant him for what they considered higher uses, prevented the enthusiastic monk from at once setting off to convert the English land. Indeed, he was already three days on his journey when he was overtaken and recalled. Prevented thus himself, he used all his enthusiastic influence to assist the mission of St. Augustine to Kent. He was recalled by Pope Pelagius II., and sent on an embassy to Constantinople to request assistance against the Longobards. On his return to Rome, after the death of Pelagius, in 590, the clergy and people unanimously elected him as his successor, notwithstanding his earnest efforts to decline the dignity. However, when he had once accepted the office, he wielded the papal authority with such vigour as had never been before known. He showed great zeal for the reformation of the abuses and corruptions which had crept into the church, as well as for the propagation of Christianity. He totally reformed the music of the church, with the results shown in the article GREGORIAN MUSIC. Gregory rebuked the Archbishop of Constantinople for assuming the title of Universal Patriarch, as being "full of pride, and inconsistent with the ancient discipline," while he himself adopted the denomination of *Servus Servorum Domini* (servant of the servants of the Lord), meaning by servants the bishops. This appellation the popes have retained ever since their assumption of universal supremacy. Gregory exercised the jurisdiction of primate of Italy, and ruled the bishops as rigidly as he had ruled his monastery. He lived in the most frugal and simple style, was averse to persecution, and considered mildness and persuasion as the only means to bring heretics to Christianity. His interest in England never flagged. He wrote numerous works, which have been collected and published by the Benedictines of St. Maur, four vols. folio, (Paris, 1707). The most important are "Moralium," libri xxxiv. ("The Great Morals," an exposition of the Book of Job; an amazing composition, treating Job as a great allegory of Christian doctrines); "De Cura Sacerdotali," being a pastoral instruction on the duties of the parochial clergy; and his "Letters," in twelve books, which contain some interesting particulars on contemporary history. He is held as the fourth great Latin "father." It is to Gregory that we owe the ordinal of the mass in its entirety: the additions since his time are quite unimportant compared to his work; and it is to him that we owe the temporal power of the popes. Coming to authority at a time of total wreck, those whom the Lombards spared being decimated by the pestilence, he showed himself a born ruler of men. He gained for Rome the peace so long absent, and the power and prestige which he caused to surround the papal chair never afterwards left it. The popes were masters of Rome. Gregory died at Rome in 604, and was succeeded by Sabinianus of Volterra.

GREGORY II., ST. (715–731), was the firm patron of St. Boniface, that English Devonshire missionary whose name was Winfrith before his ordination. He having found his way to Rome was recognized as a power by Gregory, and sent to Germany under the authority of the powerful Charles Martel, then mayor of the palace of the great Frankish realm, to convert the fierce heathen.

GREGORY III., ST. (731–741), succeeded St. Gregory II. and took up his great aims. He consecrated Boniface archbishop of Mainz and first primate of a converted Germany.

But such peaceful triumphs were only a small part of the work of these two popes. Their reigns were by far more occupied with the great contest against the worship of images in the church, which, under the name of ICONOCLASM, had arisen at Constantinople, and which is described elsewhere. The unhappy fact of the popes being favourable to image-worship (or perhaps we should rather say to the reverence of images), while the emperors were against it, resulted after a fierce controversy in the formal renunciation of iconoclasm by a considerable council of the church at Rome in 732, under Gregory III., and in Charles Martel being called upon to help to resist the Lombards, but with an after-intention that he would aid the pope in the expected conflict. Though the separation from Constantinople did not actually take place under Gregory III., the acts of his reign rendered inevitable both that separation and the intimate counter-union with the great Frankish power which came about in a few years.

GREGORY IV. (827–844) is chiefly remarkable for the disgraceful aid he afforded to the rebellious sons of the good Emperor Louis the Pious against their father, even visiting their camp when in arms.

GREGORY V. (*Bruno*, a grandson of the Emperor Otho the Great) reigned from 996 to 999.

GREGORY VI. was a certain John Gratian, an archpresbyter of great wealth and learning, and much renowned for his chastity in a dissolute age, who in 1046 *purchased* the pontificate from Pope Benedict IX., a pontiff stained with every vice and crime. The immediate cause of the sale is said to have been that Benedict loved a fair cousin of his, who refused his suit so long as he was pope; but the fact probably was that Benedict knew himself to be held in such detestation and horror that he was not disinclined to part with the crown. Once, at least, he had been driven from Rome, and an anti-pope had been crowned as Silvester III. in his stead. Nevertheless he quickly repented of his bargain, and taking the sword attacked Gregory in Rome; Silvester did likewise, and the strange spectacle was seen of three popes actually in Rome—Gregory VI. at the Basilica of Santa Maria Maggiore, Benedict IX. at the Lateran Palace, Silvester III. at the Vatican. The Emperor Henry III. was called upon to intervene, and advanced into Italy with this object. Calling a council of the greater clergy, the emperor deposed Silvester as a usurper, while Benedict found it wise not to court inquiry and resigned, and Gregory's hopes stood high. But the purchase of the holy see was so glaring a simony that he, too, at the first examination, begged to be allowed to retire from his office. He was sent to a monastery in Germany; and he had for companion in his exile the famous monk Hildebrand, subject of the next section of this article. Gregory died in 1047.

GREGORY VII. (*Hildebrand*) was born at Saona, in Tuscany, of low parentage, and became a monk in the convent of Cluny in Burgundy. Having acquired a reputation for theological and canonical learning, and for strict regularity of conduct, he afterwards went to Rome with Bruno, bishop of Toul, who was elected pope in 1049, under the name of Leo IX., chiefly through Hildebrand's influence. From that time the monk Hildebrand became the mainspring of the Roman hierarchy and the intimate councillor

of Leo and his successors, Victor II., Stephen IX., Nicholas II., and Alexander II. After the death of Alexander II., 1073, Hildebrand was unanimously elected his successor by the clergy and people of Rome, but he did not assume his title until he had received the approbation of the emperor, Henry IV., who readily confirmed his election. Hildebrand assumed the name of Gregory VII. The great object of Gregory's ambition was, as he expressed himself in a letter to Hugues, abbot of Cluny, to effect a total reform of the church, which certainly stood in great need of it. Simony prevailed throughout the Christian world, and sees were openly sold or given by sovereigns to their favourites. Gregory determined to remove the evil by taking away from the secular princes the right which they assumed of disposing of the sees within their dominions. The pope was a far-seeing and ambitious man, and lying beneath this specious plea he concealed his firm resolve to rule uncontrolled the spiritual world, and even to raise the church above temporal kings, as it had once been, or was fabled to have been. Gregory began by admonishing Henry IV.; he sent legates to Germany, but to little purpose. His next step was to assemble a council at Rome in 1074, which anathematized persons guilty of simony, and ordered the deposition of those priests who lived in concubinage, under which name were also included those who lived in a state of matrimony, and it was decreed that no one should be admitted to holy orders unless he made a vow of celibacy. Gregory summoned another council at Rome in 1075, in which, for the first time, kings and other lay princes were forbidden, under pain of excommunication, from giving the investiture of sees and abbeys by conferring the ring and the crosier. This was the beginning of the quarrel about the investiture which distracted Europe for many years afterwards.

The emperor, Henry IV., saw through the pope's whole design, and therefore paid no regard to Gregory's councils and their decrees; and he continued to nominate, not only to German, but also to Italian bishoprics. But the quarrel of the investiture, which had opened the breach between the pope and the emperor, was lost sight of in the more extraordinary discussions which followed between them. Gregory had been for some time tampering with Henry's disaffected vassals of Saxony, Thuringia, and other countries, and he now publicly summoned the emperor to Rome to vindicate himself from charges preferred by his subjects against him. Henry, indignant at this assumption of power, assembled a diet of the empire at Worms, which upon various charges preferred against Gregory deposed him. Upon this Gregory, in a council assembled at the Lateran Palace in 1076, solemnly excommunicated Henry, and in the name of St. Peter, prince of the apostles, declared him *ipso facto* deposed from the thrones of Germany and Italy, and his subjects released from their oath of allegiance. This bold act of Gregory produced for a time the effect which he had calculated upon. Most of Henry's subjects, already ripe for rebellion, readily availed themselves of the papal sanction, and a diet was assembled to elect a new emperor. Henry was acute enough to see that resistance at the moment was but folly. He managed to obtain a delay, and the matter being referred to the pope, he set off for Italy in the winter of 1077, and met Gregory at the Castle of Canossa, near Reggio in Lombardy, which belonged to the Countess Matilda, a great friend and supporter of the pope. Gregory would not see Henry at first, but insisted upon his laying aside all the insignia of royalty and appearing in the garb of a penitent, in a coarse woollen garment and barefooted. In this plight Henry remained for three days from morning till sunset, in an outer court of the castle, in very severe weather. On the fourth day he was admitted into Gregory's presence, and on confessing his errors received absolution, but was not restored to his kingdom, the pope referring this question to the general diet. Henry having gained what he wanted quietly soon after resumed the insignia of royalty, and being supported by his Lombard vassals, and indignant at the humiliating scene of Canossa, recrossed the Alps, fought several battles in Germany, and at last defeated and mortally wounded Rudolf of Swabia, who had been elected emperor in his stead, and was supported by Gregory. Having now retrieved his affairs in Germany, he marched with an army into Italy in 1081, to avenge himself on the pope, whom he had again deposed in another diet, having appointed Guibert, archbishop of Ravenna, as his successor, under the name of Clement III. After Henry had spent two campaigns in Italy, in 1084, the Roman people, who were dissatisfied with the pope, invited him to enter the city. Gregory escaped into the Castle of St. Angelo, and the anti-pope Guibert was publicly consecrated on Palm Sunday by several bishops. On the following Easter Sunday, Henry IV. was crowned by him as emperor in St. Peter's. After the ceremony Henry ascended the Capitol and was publicly proclaimed, and acknowledged by the Romans with acclamations. On the approach of Robert Guiscard, however, to the assistance of Gregory, Henry withdrew towards Tuscany, and the Norman and Saracen soldiers of Guiscard entered the city. Under the pretence of delivering Gregory, who was still shut up in the Castle of St. Angelo, they plundered Rome and committed all kinds of atrocities. Gregory, having come out of his stronghold, assembled another council, in which, for the fourth time, he excommunicated Henry and the anti-pope Guibert; but, not thinking himself safe in Rome, he withdrew to Salerno, under Guiscard's protection, where he died in the following year, 1085.

The characteristic passage of arms between Hildebrand and William the Conqueror must not be omitted. Hildebrand had procured from Alexander II. the papal blessing and a consecrated banner to aid William's descent upon England, and secure, as he thought, of William's obedience in return, he at once demanded, on becoming pope, the papal tax of Peter's pence, and a declaration of fealty. William promised the tribute, for he had agreed to it as one of the conditions of aid, but as to the other he replied, "I have not sworn nor will I swear fealty, which I have not promised, and which I cannot find was ever sworn by any of my predecessors to any of yours," and stoutly proceeded to appoint his own clergy with perfect independence.

Gregory VII. was sincere in his wishes for ecclesiastical reform, and he was himself pure and disinterested; but he was led astray by the ambition of exalting his see over all the dignities and powers of th earth, spiritual as well as temporal. He even planned a crusade, long before Peter the Hermit (see Gregory's *Regesta* in several places), and intended to head it himself. The strife with Henry prevented this scheme from being carried out.

GREGORY VIII. (*Albert di Mora*) only reigned two months, from October to December, 1187; but he had time to send earnest letters to all Christendom upon the fall of Jerusalem, which may be said to have brought about the third Crusade, in which Barbarossa, Richard of the Lion-heart, and Philip Augustus of France took part. In 1172 it was Di Mora who, as cardinal legate, absolved our Henry VI. at Avranches from the murder of A'Becket.

GREGORY IX. (*Ugolino de' Conti di Segni*) is best known as the bitter enemy of the chivalrous, noble-hearted Frederick II. He was eighty years old at his accession in 1227, a pious, learned, narrow, obstinate, severe man—the exact antithesis to the brilliant young sovereign whose Sicilian court was the joy of the knightly world, full of colour, song, and poetry, and, though far from rigid in its morals, yet not dissolute. Frederick had vowed a fifth Crusade, and did indeed set sail in 1227, but returned after three days much indisposed. This illness was unjustly thought to be feigned by the pope, and he forthwith

excommunicated Frederick with every circumstance of terror, the bells clashing, the clergy fully assembled with huge torches, which they throw down against the altar, leaving the church in smoke and darkness, and the continual thunder of curses. Frederick, as was to be expected from his nature, did not treat the excommunication with the slightest respect. He even issued a counter oration, and invited the sovereigns to join him in putting down the overweening claims of Rome, reminding England of the interdict under John, and so with the other countries. Gregory retorted with a second excommunication inflicting further penalties, such as absolving Frederick's subjects from allegiance. The Romans, many of whom loved the brilliant young emperor, rose against the cursing old man and drove him out of Rome. He fled to Perugia, a town on an almost inaccessible isolated rock (Easter, 1228).

Frederick meanwhile had recovered and prepared for the Crusade, setting sail in April, 1228, and really did secure, by negotiation with the Sultan Kameel, a considerable benefit for Christians. He could have done more had not Gregory gone to the most preposterous lengths in his hostility, surrounding him with traitors who undermined his influence and betrayed him continually, even informing Kameel of Frederick's design to bathe alone in the Jordan on one occasion. The chivalrous sultan sent the letter to the emperor. Frederick obtained by formal treaty the restitution of Jerusalem, went thither and was crowned king. He was at once met by the whole city being placed under a papal interdict, and thus disgrace was publicly announced in face of the Mohammedans. On his return to Italy he was received, not as a benefactor, but a traitor and heretic, a friend of Mussulmans, if not himself secretly a Mussulman; for such were the anathemas hurled at him by the pope from his rock. Frederick quietly showed Gregory's letters to the sultan trying to defeat the Crusade, and though the pope denied them they were believed genuine. Men began to tire of the angry obstinacy of the pope. He tried to get up a crusade, as he called it, against Frederick, but failed so utterly that in 1230 he consented to make peace. He had shortly before this returned to Rome, which had opened its gates in a fit of superstitious repentance caused by a heavy flood, which they attributed to the wrath of God at their treatment of Gregory. The pope and the emperor met at Anagni and kissed each other in token of peace.

The feud for a time at an end, the remarkable old man who so vigorously wielded the sword of Peter, turned with almost the elasticity of youth to a great task of legislation in the church, the compilation of the Decretals of the various popes. Raimond da Pennaforte was the principal author of this important digest, and when completed it was promulgated as the statute law for the world, seeing that as the church was above the state so should the laws of the church supersede those of the state. No more sweeping claim was ever made, even by Hildebrand himself.

In 1236 Frederick's son Henry rebelled, and was largely supported by the great cities of Lombardy. The emperor therefore made war upon them. Gregory began to tremble, for as these cities fell one after the other, he saw the papal territory gradually being hemmed in by a strong imperial power, and the pope in future a vassal of the empire. The independence of the Lombard cities became a matter of life and death to him. He was ninety-two when he proceeded for the fourth time to excommunicate Frederick (Palm Sunday, 1239), secure in alliances which he had secretly made with Venice, Genoa, and other great cities. Frederick replied in a dignified letter to the chief sovereigns of Europe, easily overcoming his antagonist on paper. Later proclamations became more bitter on both sides. Henry III. of England had recently married his sister Isabella to Frederick, and feeble prince though he was, he remonstrated with the pope on his calumnious accusations of the emperor. Gregory, defeated in England, tried France, with a promise of the imperial crown to the king's brother, Robert. The French nobles (like Sultan Kameel) at once sent full particulars to Frederick. Still not despairing, Gregory tried some German princes, again in vain. Finally, he attacked the emperor by means of the friars, a barefooted army. Nothing availed; Frederick advanced nearer and nearer, until the year 1241 saw him in sight of Rome. It was said that Gregory's heart broke at the sight of his enemy's watch-fires; but a summer heat in a besieged city would seem sufficient cause to overcome the strength of a man of ninety-four. Gregory IX. died 21st August, 1241.

Gregory X. (*Tebaldo Visconti*), 1271–76, was the last crusading pope. He was elected while absent on a pilgrimage to the Holy Land. He determined on a last and greatest Crusade, and bent his whole energies to the pacification of Christendom to insure its unity and success. In this preliminary object he succeeded most remarkably, but he died before the Crusade could be begun. Men heard with amazement the pope, hereditary head of the Guelfs, say to them, "These others are Ghibellines, but yet they are also citizens, men, and Christians." At Florence and at Siena Gregory worked the miracle of bringing Guelfs and Ghibellines into amity. He even obtained an engagement from the usurping Greek emperor, Michael Palæologus, for the reunion of the churches, and the second Council of Lyons (1274), summoned by universal consent, for this purpose and to decree the Crusade, saw the arrival of ambassadors with splendid offerings for the altar of St. Peter's from Palæologus (24th June, 1274). The creed, with the *filioque*, acknowledging the procession of the Holy Ghost from the Father and the Son (and not limiting it, as by Greek usage, to the Father only), was publicly recited by the Greeks. This concord lasted but a few years, it was but a disingenuous bribe from the Greek for papal aid in his usurpation of the empire. Gregory also set before the council minute rules for governing future conclaves of cardinals when assembled to elect a pope. These rules form the well-known ceremonial still observed almost without modification, bringing imprisonment and almost starvation into play (or assuming to do so) to force the cardinals to an election. [See Conclave.] Unhappily Gregory's sudden death, in January, 1276, once more broke up the union of Christendom he had with such remarkable success promoted. The Crusade was abandoned, and the old feuds raged fiercely again in Europe.

Gregory XI. (*Pierre Roger*) was one of the Avignon popes, nephew of Clement VI. He was elected in 1370 after the return of Urban V. from Rome to Avignon, and the cardinals trusted no doubt that they should never again be compelled to leave luxurious Avignon for stormy Rome. Yet it was this thorough Frenchman, the last Frenchman ever acknowledged as a true pope, who actually restored the throne of St. Peter to Rome. Denounced by St. Bridget of Sweden in fiery visions wherein Christ spoke by her mouth (the collection fills two huge volumes), implored by the loving hearted St. Catherine of Siena, who came to Avignon to urge her plea, and driven by his own high sense of rectitude, Gregory XI. at last braved all opposition, and almost suddenly, in 1376, set sail for Rome. His attempt to recover the heritage of the popes by force failed, while it led to great bloodshed. The whole of Italy was irreparably sunk in desolation and anarchy, and Gregory even thought of fleeing to Avignon. He died, worn out with anxiety, 28th March, 1378, and a fierce schism followed his death, Urban VI. ruling at Rome, and Clement VII. at Avignon. Gregory XI. is noteworthy to Englishmen as having formally condemned the doctrines of Wyclif in 1373.

Gregory XII. (*Angelo Corario*) was nearly eighty at his election in 1406. The schism which had broken out

on the riotous forced election of the Roman Urban VI., at the death of Gregory XI., when the French cardinals fled to Avignon and elected the French anti-pope Clement VII., subsequently installing themselves at Avignon once more, still raged. Benedict XIII. had succeeded Clement VII. at Avignon; Urban VI., Boniface IX., Innocent VII., had reigned at Rome. At the election of Gregory great efforts were made to compose the schism, now twenty-eight years in existence. All the fifteen cardinals present took an oath (Corario the most earnestly of all) that whoever should be elected should offer to renounce the pontificate if Benedict would do so likewise, and the united church should then proceed to a fresh election. After his election Gregory renewed his vow repeatedly, with the most earnest asseverations. Benedict agreed to the compact, and Savona was fixed upon as the meeting-place; but the two old men (Benedict was nearly as old as Gregory) shuffled and prevaricated and lied, one as badly as the other, and neither ever arrived at Savona. Eventually the King of France called on the University of Paris to declare upon the question, and in 1408 he began active measures by sending to arrest Benedict. The anti pope fled to Spain, and his rival Gregory took refuge in his native Venice. A number of cardinals met at Leghorn and summoned a council at Pisa for the next year to elect a fresh pope and depose these two. *Peter Philarzi*, a Franciscan, was elected by the council, and took the title of Alexander V. The grave importance of the matter lies in the fact that for the first time for many centuries the authority of the church in council was recognized as superior to that of the pope. Venice agreed to the decision of the council, and Gregory, who was now almost deserted, was driven forth. At the price of immense bribes of papal territory Ladislaus, king of Naples, took up his cause, and the aged man once more was seen in Rome. But the French and the Florentines invaded the papal dominions, and Rome fell almost without a struggle. Gregory fled to Gaeta, and then, apprehensive lest he might be delivered into the hands of the new church pope, John XXIII., he availed himself of the alms of the townspeople of Gaeta to purchase a passage to Rimini in the Venetian states. There he died in 1415, while the Council of Constance was actually engaged in once more deposing him, together with his old rival Benedict and the vile Pope John.

GREGORY XIII. (*Ugo Buoncompagno*) reigned from 1572 to 1585. In the year of his accession the massacre of St. Bartholomew took place, and he celebrated a *Te Deum* of gratitude; but it has been said that this was in consequence of misrepresentation of the nature of what had occurred. It certainly was foreign to his nature. He was pre-eminently a lawyer, versed both in the civil and the canon law, and had taken an active part as a young man in the Council of Trent. His zeal for education was considerable, and his expenditure on this head generous even to lavishness. It is to this pope that we owe the *Gregorian Calendar*, which at present governs our chronology, a reformation forced upon his accurate mind by the manifestly incorrect observance of Easter. The corrections were very carefully thought out, and a remarkably simple and accurate reform was the result. The Gregorian Calendar was promulgated in 1582. [See CALENDAR.] Gregory XIII. died at the age of eighty-three in 1585.

GREGORY XIV. (*Nicolo Sfrondate*), elected in 1590, reigned a few months. He excommunicated Henri Quatro as a heretic (before the king's conversion, of course), and ordered an army to be levied in his name to depose Henry.

GREGORY XV. (*Alessandro Ludovisi*), 1621–23, is best known as the founder of the *Propaganda*. This college originated among the educational institutions of Gregory XIII., and as formally arranged by Gregory XV. it forms the centre of missionary enterprise for the Roman Catholic Church.

GREGORY XVI. (*Bartolommeo Alberto Capellari*) reigned from 1831 to 1846. The downfall of the Bourbons in France in 1830 caused a republican rising in Italy, especially in the Papal States, and as Gregory, though personally kind-hearted, was an enthusiastic, even, one might say, a bigoted churchman, he lent his name to measures of terrible cruelty and oppression to crush the liberal movements. Wholesale imprisonments, and even many executions, marked his reign; so that when his successor Pius IX. (*Pio Nono*) appeared to be infused with liberal ideas he found himself the most popular pope for centuries. Unhappily the good understanding between him and his people (regarding him as a temporal prince) was not destined to endure. Certainly the eagerness of the population to shake off the papal yoke is largely to be attributed to the cruelty and bigotry they suffered from under Gregory XVI.

GREGORY, ST., NAZIAN'ZEN (*i.e.* of Nazianzus), one of the fathers of the church, was born in the early part of the fourth century, at Arianzus, a village near the town of Nazianzus in Cappadocia, of which town his father was bishop. He studied at Cæsarea, at Alexandria, and at Athens, where he became the friend and companion of Basil the Great and Julian the Apostate, afterwards emperor. Basil and he retired into the desert at Pontus on the completion of their studies. Both were recalled by force from their hermitage, and Basil being soon after made bishop of Cæsarea, appointed Gregory bishop of Zazime, a place which he soon after left to join his father, and assist him in the administration of the church at Nazianzus. He had suffered with his brethren from Arian persecution in the reign of Valens, and after that emperor had taken by violence all the churches of Constantinople from the orthodox Niceans, Gregory came to Constantinople, and took the direction of a private chapel, which he named Anastasia. Theodosius, when he later on came to the throne of the empire, having triumphed over his enemies, declared himself in favour of the orthodox communion. Gregory had long been declared archbishop by the orthodox, and was then in consequence under imminent danger of death from the powerful Arians, yet now that the tables were turned he did not retaliate upon the Arians, but endeavoured to reclaim them by mildness and persuasion.

In the midst of the pomp of the court he retained his former habits of simplicity. His conduct soon drew upon him the dislike of the courtiers and of the fanatical zealots. Theodosius convoked a council of all the bishops of the East, which at first acknowledged Gregory as archbishop; but soon after factions arose which disputed his title to the see, and stigmatized his charity towards the now persecuted Arians as lukewarmness in the faith. Gregory, averse to strife, offered his resignation, which the emperor accepted. Having assembled the people and the fathers of the council, to the number of 150, in the church of Santa Sophia, he delivered his farewell sermon, which is a fine specimen of pulpit eloquence. This oration was delivered in June, 381, and a few days after Gregory was on his way to Cappadocia. He eventually withdrew to Arianzus, where he spent the latter years of his life, busy in the cultivation of his garden and in writing poetry, a favourite occupation with him from his youth. Gregory died in 389. Most of his poems are religious meditations. He received the honourable title of "the theologian" from a posterity admiring his great ecclesiastical learning. But Gregory's true strength lies in his eloquence, and in the poetical feeling which transfuses his treatment of every subject, sometimes rising to a grandeur unattained by any other "father." Over fifty orations have been preserved. The best edition of Gregory, in the original Greek, is that of the Benedictines and Caillau (Paris, 1842, in two vols. folio).

GREGORY, ST., OF NYSSA, in Cappadocia, the brother of Basil the Great, bishop of Cæsarea, died about 396; he distinguished himself in the Arian controversy.

Like his great brother-bishops of Asia, Gregory of Nazianzus and Basil, Gregory of Nyssa suffered much persecution at the hands of the Arians in the time of Valens, and it was not until the accession of Gratian (in 378) that he began to be a power in the church. The three bishops made a remarkable group; the acumen of Basil and the fervour of the Nazianzene were supported by the accurate philosophical knowledge of Gregory of Nyssa, and it is to their great united strength, wholly and unceasingly put forth in favour of the Nicene Creed and against the Arian faith, that the downfall of the latter creed is largely to be attributed. Gregory of Nyssa draws largely from the great philosophers of antiquity; Plato is his avowed master, and the source of much of his power. At the same time he was great enough and bold enough to proclaim the grand truth that religion is a life rather than a creed, a glowing enthusiasm rather than a dogma. But though many were shocked at such a saying in those narrow times, the good bishop was highly honoured during his life, being charged with a sort of inquisitorship over all Pontus by the great Council of Constantinople in 381, and made metropolitan in 383; while after his death he was held in still greater reverence, and received the title of "Father of the Fathers" (Pater Patrum) by a special decree of the second Council of Nice (Nicaea) held in 787.

Gregory was married when young, happily and honourably; but being warned in a vision he put his wife sorrowfully aside and entered the church. It is perhaps in consequence of this that we get the curious mixture of practical acquaintance with everyday thoughts and feelings, and the highly-wrought mystic and poetic subtleties of a modified Platonism that characterize Gregory of Nyssa. His writings are voluminous, are of course in Greek originally, but are also easily accessible in Latin in several editions. The best Latin edition is the Paris one of 1603, and the best in Greek and Latin together is the Paris edition of 1638.

GREGORY, ST., THAUMATUR'GOS, one of the primitive fathers of the church, a native and afterwards bishop of Neo-Cæsarea, in Cappadocia, and a disciple of Origen of Alexandria. He died soon after the Council of Antioch, which he attended, in 264. We have of him a "Metaphrasis in Ecclesiasten," a "Brevis Expositio Fidei," an "Epistola Canonica," and a panegyrical oration to his master Origen, on leaving his school. Gregory's name of Thaumaturgos, "worker of miracles," is due to a remarkable series of miracles he is said to have wrought in order to convert the heathens of Neo-Cæsarea, turning water into land, moving stones, &c., and also the famous miracle whereby, when hotly pursued during the Decian persecution, he escaped and saved the life of the follower who accompanied him by both of them being changed for the time into trees.

GREGORY OF TOURS, born in 540, of a family of Auvergne, was nephew to Gallus, bishop of Clermont, who took care of his education. He was made bishop of Tours in 573, attended several councils, and distinguished himself by his courage and firmness in denouncing the guilty conduct of Chilperic and Fredegonda, who reigned over France. His boldness exposed him to persecution occasionally. He is said by himself to have visited Rome, but later biographers find great reason to doubt this. He retired to Tours, where he died in 595. He wrote in Latin a history of France, from the first establishment of Christianity till the year of his death. Gregory is the father of the French historians, and the only one who has left us an account of the early Merovingian kings.

GREI'SEN is a granular-crystalline rock composed of quartz and mica (lepidolite), the former mineral largely predominating. It occurs usually associated with granite, gneiss, or quartzite, and often graduates into one or other of them. It is probably of metamorphic origin, and in some districts CASSITERITE occurs in strings and veins through it.

GRENA'DA, one of the Lesser Antilles, West Indies, lies between 11° 58′ and 12° 30′ N. lat., and between 61° 20′ and 61° 35′ W. lon.: its greatest length N. to S. is 25 miles; its greatest breadth, 12 miles; and its area, 133 square miles. This island was discovered by Columbus on his third voyage in 1498, at which time it was inhabited by Caribs. In 1650 Du Parquet, governor of the island of Martinique, having collected a body of 200 adventurers, landed on Grenada, and formed a settlement. The colonists in a very few months commenced a war of extermination against the Caribs, every one of whom on falling into the hands of the French was murdered. In 1762 the island was surrendered on capitulation to the English, and by the definitive treaty of Paris, signed in February, 1763, Grenada was finally ceded to Great Britain. In 1779 the island was taken by the French under Count D'Estaing, but was restored at the general peace in 1783, and since that time has remained in possession of the English.

The island is traversed throughout its whole length from north to south by an irregular range of mountains, rising in some places to a height of more than 3000 feet. Several small rivers rise in the highlands. The soil consists principally of a rich black or reddish-coloured mould. It is fertile, and these are about five-eighths under culture. In the low ground the heat is often oppressive, but on the hills the atm[illegible] sp[illegible] ol[illegible] nt. G[illegible] considered healthy. The population in 1881 was 42,403.

Grenada is a crown colony under the general government of the Windward Islands. The annual revenue and expenditure of the island are each about £23,000. Between 300 and 400 vessels trade to this island annually, the majority from the other West Indian islands and from the United Kingdom. The average value of the imports and exports is about £120,000 each per annum. The principal articles imported are butter, flour, and dried fish; exported—cocoa, cotton, rum, coffee, sugar, molasses, and fish-oil.

Grenada is divided into six parishes. The chief towns are St. George, the capital, Charlotte-town, and St. Mark on the west, St. Patrick on the north, and St. Andrew on the east coast. Between Grenada and St. Vincent there is a group of islands known as the Grenadines, some of them belonging to the government of Grenada.

GRENADE, frequently called *hand-grenade*, is a shell or hollow ball of iron, $2\frac{1}{2}$ inches in diameter, which, being charged with powder and provided with a fuse, is thrown from the parapets into the ditch and covered-way when occupied by the besiegers, or from the covered-way into the trenches when the latter approach within 25 yards of the crest of the glacis. As soon as the composition in the fuse is consumed the fire communicates with the powder, and the ball is burst in fragments. Grenades have also been made of annealed glass, provided with a fuse, or with four or five nipples distributed over the surface, on which percussion caps are placed, which explode by the blow of the shell falling on the ground, and cause the ignition of the charge. Grenades are now but little used in warfare owing to the changes in tactics rendered necessary by the introduction of the breechloader, but a more effective weapon has been introduced both into the naval and land services in the gun-cotton slab.

GRENADIER' GUARDS, the first regiment of foot guards in the British army. It was first raised in 1660, and has always kept a high position in the service, distinguishing itself especially in the Peninsula, at Waterloo, and in the Crimea. The officers belong to the highest families in the land. The regiment is divided into three battalions, and according to the estimates for 1884–85, comprised 2543 officers and men, of whom 2250 were privates. The regimental pay alone is £71,000 per annum. The colonel has £2200 per annum, the officers sums varying from

26*s*. 9*d*. to 5*s*. 6*d*. a day, and the non-commissioned officers from 3*s*. 9*d*. to 1*s*. 5*d*.

GRENO'BLE (the ancient *Cularo* and *Gratianopolis*), the capital formerly of Dauphiné, now of the French department of Isère, is situated on the Isère, just above its junction with the Drac, 345 miles S.E. of Paris, and had 44,040 inhabitants in 1881.

The part of the town on the right bank of the Isère is called St. Laurent. It consists of one spacious street, which has been embellished by the construction of quays along the river; it communicates with the rest of the town by two stone bridges, and by an iron chain bridge, the approaches to which are adorned with some handsome modern buildings. Immediately behind the street rises a hill, the lower part of which is called Rabot; higher up it takes the name of Bastille, from an old feudal castle that once stood on it, and the summit is called Mont Rachel. The greater part of this hill is covered with formidable fortifications, the guns of which can sweep the valleys of the two rivers. The view from Mont Rachel is very picturesque, presenting as in a plan the town and its fortifications, the valley of the Drac on one side and of the Isère on the other: the view up the Isère is terminated by the snowy mass of Mont Blanc. This part of Grenoble was formerly surrounded by an ancient wall, which has been demolished and replaced by a handsome promenade. The quarter of Bonne on the left bank is also fortified, and Grenoble is now considered one of the strongest fortresses in France. This part of the town is extensive; the streets are well laid out, and the houses are good. Among the principal buildings are the Palais de Justice, originally the palace of the dauphins, and a building of great interest; the court-house; the town hall, once the residence of the Constable Lesdiguières; and the building occupied by the college, by the public library of nearly 200,000 volumes, by the museums of natural history and antiquities, and by the gallery of paintings. The other remarkable objects are the Cathedral of Notre Dame, the episcopal palace, the hospital, the colossal bronze statue of Bayard (who is interred in a contiguous church) in the Place St. André, the arsenal, the botanic garden, several handsome fountains, the theatre, and the public walks. The town is well lighted with gas.

The chief manufactures of Grenoble are kid gloves, of which large quantities are exported to England and America annually; liqueurs, chamois and other leather, perfumes, and silk goods. The dressing of hemp gives employment to about 1000 workmen. The trade of the place is much promoted by the navigation of the Isère; other articles of trade are wrought iron, marble, and timber, the products of the neighbourhood.

Grenoble is the seat of a bishop, whose see is the department of Isère; of a high court and university academy, which have jurisdiction over the departments of Isère, Drôme, and Hautes Alpes. There are two faculties of law and science in connection with the academy. The town has also a college, a school of medicine, a school for the artillery, two seminaries for the priesthood, a botanic garden, at which courses of instruction are delivered, and other institutions. Grenoble is the headquarters of a military division, which includes the departments of Isère, Drôme, and Hautes Alpes. It has also tribunals of first instance and of commerce, and an exchange.

Grenoble was the first place which openly received Napoleon on his return from Elba in 1815. It is the birthplace of Bayard, Condillac, Vaucanson, Dolomieu, &c.

GREN'VILLE, RIGHT HON. GEORGE, an English statesman memorable for having founded in his two years of office, by his ill-considered measures, the liberty of the press and the independence of America, was born in 1712. The shifty policy of George III., anxious to free himself from the mastership of Pitt, brought Grenville to the front on the fall of Bute in 1763. Public opinion, left without means of expressing itself in Parliament, so corrupt was the House of Commons at the time, had driven Bute from office by attacks in the press. Wilkes in the *North Briton* was the most inveterate of all. Grenville was foolish enough to send Wilkes to prison on a state warrant, to close his mouth. The warrant did not even name the prisoner, and the outcry was so great at this arbitrary proceeding that no such warrant has ever since been issued. Wilkes was released by means of a writ of Habeas Corpus. Grenville issued injunctions against 200 newspapers. Then began the famous shouts of "Wilkes and liberty," which showed even Grenville that he dare not tempt the English people further. Six years later the failure of the Junius prosecutions in 1770 established the freedom of the political press, but the battle was really lost by Grenville in 1764.

Beaten in his first attempt at tyranny Grenville nevertheless made a second and more famous endeavour. The great Seven Years' War had ended by giving us India and adding Canada to our American colonies, but the long contest with France for these countries had raised the debt to £140,000,000—a figure which then seemed crushing in its vastness. Grenville determined that as the defence of the American colonies had cost a large part of the amount these colonies should pay a heavy share of it. He therefore imposed large duties at their ports, and stopped all trading except with England, as by an old law he had a right to do. Thus far the colonists, though angry, bore the blows. But his third measure was the famous stamp duty, a scheme of excise within the colonies. The colonists at once met to resist this interference with their own internal affairs, but offered a larger sum as supplies, and sent Benjamin Franklin to England as their mouthpiece. Grenville would listen to nothing, and the Stamps Act was passed in 1765. The terrible troubles which at once began overthrew the Grenville ministry, not the least of the discontents being King George himself, to whom the minister had been as arrogant as to the press and the colonies. In vain was the Act repealed, the rebellion once began steadily progressed, till American independence was acknowledged. Grenville died in 1770.

GREN'VILLE, RIGHT HON. THOMAS, an accomplished statesman and classical scholar, was born in 1755, and was the son of the Right Hon. George Grenville. [See above.] As the son of one who had been a minister of the crown, Mr. Thomas Grenville early took his seat in the House of Commons under the most favourable auspices; but he became a follower of Charles Fox, and so highly did that minister appreciate his talents and influence, that if the celebrated India Bill brought in by that minister had proved successful, Grenville was to have been appointed governor-general. By a curious train of circumstances, while his father had been the prime instigator of the American War, when it was approaching to a close Grenville was appointed plenipotentiary, on the part of this country, to negotiate at Paris the terms of peace. But a change of ministry broke off the intended negotiations. At the general election of 1784 he lost his seat, and afterwards withdrawing from public life he devoted himself, with considerable success, to the cultivation of classical literature, for which he was in after-life so distinguished. In 1790, however, he was returned for Aldborough, and in 1796 for Buckingham. At this period he withdrew himself from Fox, on account of the latter's strong advocacy of the French Revolution, and gave his cordial support to the government—Lord Grenville, his brother, being then foreign secretary. In 1795 Grenville was appointed minister-extraordinary to the court of Berlin, with the view of engaging the Prussian monarch to unite with England and her allies in resisting the aggressive spirit of republican France; but in this mission he was altogether unsuccessful.

In 1800 he was appointed, as some compensation for his disappointments, to the sinecure office of chief-justice in eyre south of Trent; but by the 57 Geo. III. this office was abolished, and Grenville was the last of its functionaries. On the death of Fox in 1806 he was made first lord of the admiralty, which he resigned the following year. Indeed his public life may be said to have reached its close when the ministry of which his brother was the head made way, in 1807, for the readmission of the Tories. The society of scholars and the enjoyment of literature became then more attractive than the collisions of political party and the midnight vigils of the House of Commons. He died in 1847, and by his will he left his magnificent library of rare and costly books, consisting of 20,000 volumes and valued at £42,000, to the library of the British Museum. The collecting of these books occupied nearly fifty years of his life; and his will contains the following passage, in allusion to this magnificent bequest:—"A great part of my library has been purchased from the profits of a sinecure office given to me by the public; and I feel it to be a debt and a duty that I should acknowledge this obligation by giving that library, so acquired, to the British Museum for the use of the public."

GREN'VILLE, LORD WILLIAM WYNDHAM, was the third son of the Right Hon. George Grenville, and was born on the 25th of Octob[illegible] 17[illegible] He [illegible] educated at Eton and Oxford, entered Parliament in 1782 as member for Buckingham, and soon succeeded Burke as paymaster for the army. In 1789 he became speaker, and left this office to become home secretary. In 1790 he was raised to the peerage in order to represent the younger Pitt in the Upper House. In 1791 he became foreign secretary. He was active in promoting the union with Ireland, and in advocating the emancipation of the Catholics against the opposition of the king. Eventually the ministry resigned in 1801 on this question. When Pitt returned to office in 1804 without the king having been induced to give way on the Catholic question, Lord Grenville refused to join the ministry. In 1806 Pitt died, and Grenville at once became prime minister. His government by the "ministry of all the talents" lasted only thirteen months. The great Fox died almost at once, and the Berlin Decrees of the Emperor Napoleon, shutting the whole coast of the Continent against British ships, crippled commerce. Lord Grenville retaliated by threatening to seize any ship which carried goods to the Continent and tried to pass the English blockade, if it had not previously touched at some English port. This might have led to terrible disasters. But the fall of the ministry was not due to its follies; it was the noble Act for the abolition of slavery, introduced by Lord Howick (afterwards Earl Grey) in the House of Commons, and passed into law in February, 1807, which caused it to totter, and an equally noble effort in the old cause of Catholic emancipation, which caused it to fall in March. George III. demanded at once that the question should be abandoned, and on Lord Grenville's refusal dismissed the ministry. Lord Grenville died in 1834.

GRÈS is a term sometimes used instead of sandstone.

GRESH'AM, SIR THOMAS, was descended of an ancient family of Norfolk, and was born in London in 1519, and studied at Gonville (now Caius) College, Cambridge; but was afterwards bound apprentice to his uncle, Sir John Gresham, who also belonged to the Mercers' Company. Thomas Gresham took out his freedom in 1543. In 1551 he was employed in negotiating foreign loans by Edward VI. He was knighted by Elizabeth in 1559, and was often consulted by her in political and commercial affairs. By his advice the experiment of raising money at home rather than from foreigners was first tried by Elizabeth in 1569, and followed with great advantage both to the crown and the nation. He built a noble house on the west side of Bishopsgate Street, where he was occasionally commissioned by the queen to receive and entertain foreign visitors of high rank. He died suddenly, 21st November, 1579, leaving no children, except one natural daughter.

In the foundation of the Royal Exchange Sir Thomas Gresham has left a lasting memorial of his wealth and commercial shrewdness, and in that of Gresham College of his benevolence. The original building of the Exchange was destroyed in the great fire of 1666.

GRESH'AM COLLEGE. Sir Thomas Gresham by his will founded this college, vesting his house in Bishopsgate Street, after the death of his wife, in the corporation of the city of London and the Mercers' Company, in trust to preserve it for the residence of seven skilful teachers; four, of the sciences of divinity, astronomy, music, and geometry, to be appointed by the corporation of the city; three, of law, physic, and rhetoric, to be appointed by the Mercers' Company. A stipend of £50 was made payable to each out of the rents of the Exchange. The lectures are now delivered in a lecture-hall, situated at the corner of Basinghall and Gresham Streets, and built out of the accumulated fund.

GRESSO'RIA is a suborder of ORTHOPTERA, an order of insects. In this suborder are included two families, Mantidæ and Phasmidæ, the last of which includes the walking-stick and leaf insects. The hind legs are slender, adapted for walking or running, and not for leaping. In the Mantidæ the fore legs are converted into powerful raptorial organs; their femora are deeply grooved beneath for the reception of the tibiæ in repose; the prothorax is greatly elongated. In the Phasmidæ the fore legs are ordinary walking limbs and the prothorax is short. The Mantidæ prey on insects and are remarkable for their voracity; the Phasmidæ live entirely on vegetable matter, [illegible] present a very striking resemblance to bits of twigs, leaves, &c.; wings are often absent.

GRETNA GREEN, the name often applied to the village of Springfield, in Dumfries, Scotland, being in reality the name of a farmstead in the neighbourhood. It was once celebrated for the clandestine marriages of fugitive lovers, but has now lost its long-privileged immunities. In the session of 1856 it was enacted that after the 1st of January, 1857, no marriage should be valid in Scotland unless the parties had both resided there for six weeks preceding the wedding day; thus virtually annihilating the custom of secret runaway marriages, which had existed from the period when Fleet marriages were abolished in 1754. The old marriage ceremony merely amounted to an admission before witnesses that certain persons were man and wife; such acknowledgment being sufficient, provided it were followed or preceded by cohabitation, according to the law of Scotland, to constitute a valid marriage. A certificate to this effect having been signed by the officiating priest (who was seldom above the rank of a tradesman), and by two witnesses, the union, under the above condition, became indissoluble. The marriages of this sort celebrated at Gretna Green, when the place was most flourishing, were estimated at between 300 and 400 a year. The people were generally from England, and of the lowest ranks; though there were a few instances of persons of the higher ranks, and even of a lord chancellor, having had recourse to the services of the *soi-disant* parsons of Gretna Green. A trip to Gretna, or the presence of a self-dubbed parson, was not, however, at all necessary. Parties crossing the Scottish border, and declaring before witnesses that they were man and wife, were, under the old law of Scotland, held to be duly married.

GRÉTRY, ANDRÉ E. M., a French operatic composer of great merit, was born at Liège in 1741. Some juvenile compositions attracted the notice of lovers of music, although he had been dismissed from the choir of St. Denis as incapable, and had quite failed in an attempt to study

harmony. He was enabled by their assistance to go to Rome, walking the whole way, as he says in his "Memoirs," with a smuggler for his companion. His stay in Rome was apparently of little service. His master in counterpoint gave him up as hopeless; and indeed Grétry never did nor could learn to do anything more profound than to write pretty and appropriate melody. His manifest vocation was French opera, and in 1767 he managed to get to Paris and to find opportunities of essaying his powers in that direction. His success was almost instantaneous. Not less than fifty operas are known from his pen. One of these, "Richard Cœur de Lion," is still heard upon the stage, but the thin harmonies and want of concerted effects have banished the rest except from concert programmes.

Grétry was altogether the child of his epoch. He was one of the first to be appointed in the Conservatoire, and was put upon the institution in 1795. Napoleon later on selected him as one of the first to be decorated with the legion of honour, and added the unusual accompaniment of a pension to the title.

Grétry died in 1813 at Rousseau's old residence, the Hermitage, at Montmorency, which he had bought. His funeral was a public one of considerable splendour. What is to us of this day even more interesting than his operas (except "Richard," "Le Tableau parlant," and "Zemire et Azor") is his "Memoirs or Essays on Music" (1797). So amusingly is this filled with the author's own personality that it has been well said the title should be "Essays on *my* Music."

GREUZE, JOHN BAPTIST, an eminent French painter, born at Tournus, near Macon, in 1726, and educated at an art school in Lyons. He was one of the first French painters to go to nature for his subjects, and like our own Wilkie delighted in portraying scenes of rural life and incidents of a touching simplicity. He was a man of real genius, and, as is always the case with such minds, with a keen perception of humour (again like Wilkie). His pictures range from the laughable "Broken Pitcher" to the solemn and pathetic "Father's Curse." These well known pictures (at the Louvre, Paris) are perhaps even excelled in interest by the "Village Bride." In our own National Gallery Greuze is unhappily represented only by a few heads of girls, where all the trickiness of his style comes out, and his best qualities are not shown. His paintings now command fabulous sums, though in the stormy revolutionary times in which he lived it is little wonder that during his life his art was but poorly paid. At times he suffered grinding poverty. He died in 1805.

GREVILLE, CHARLES CAVENDISH FULKE, eldest son of Charles Greville, a descendant from the fifth Lord Warwick and Lady Charlotte Cavendish Bentinck, daughter of the third Duke of Portland, was born 2nd April, 1794. He was educated at Eton and Oxford, and in 1821 he was appointed clerk of the council in ordinary, an office which he retained for nearly forty years. His position in the social world and the nature of his official duties afforded him splendid opportunities of observing the less known causes and details of public events, as well as of making the acquaintance of most of the men of eminence of his time, and early in life he commenced the keeping of a journal of his observations, which he designed for ultimate publication. He died 18th January, 1865, having previously intrusted his papers to Mr. Henry Reeve, the registrar of the Privy Council, for publication. Of the material thus placed in his possession, Mr. Reeve published in 1883 those portions of the journal which extend from 1818 to 1837, and they at once attracted the most widespread attention. Filled with new and interesting anecdotes of the most illustrious men of the period, and revealing much concerning the inner life of the court and political proceedings, they were yet more remarkable from the caustic severity with which the author criticised certain personages of high rank and exalted position. The remainder of the journals, which the editor declares contain still more interesting and valuable matter, are for the present withheld, and their publication is anticipated with considerable interest. Immediately after the publication of this journal, some portions of the diary of Henry Greville, the younger brother of Charles, were published by his niece, the Viscountess Enfield. The extracts extend over the period from June, 1832, to September, 1852, but they are of not such great value as the work of Charles.

GREVILLE, FULKE (LORD BROOKE), was born at Beauchamp Court in Warwickshire, the residence of his father, Sir Fulke Greville, in 1554. He was educated at Shrewsbury, where Sir Philip Sidney was his schoolfellow. The two friends went together to Oxford, and young Greville afterwards studied also at Cambridge. After some time spent in foreign travel, he returned to England, and soon stood high in Elizabeth's favour, being knighted by her. Sidney bequeathed him half his library. His favour continued under James I., who granted him Warwick Castle, appointed him chancellor of the exchequer (1615), and gave him various offices about his person. Throughout his life Greville was the friend of poets and scholars, always ready to help them as he could. Charles I. created him Lord Brooke in 1627, and he signalized his peerage by establishing the lectureship of history at Cambridge. He kept the poet Davenant in his house as a youth. On 30th September, 1628, Lord Brooke was murdered in a fit of passion, or probably of madness, by a servant who had served him long and faithfully. His "Life of Sir Philip Sidney" is excellent; and his poems, posthumously printed ("Certain Learned and Elegant Works by Right Hon. Fulke Lord Brooke," 1633), are, though difficult at first sight from their quaintness and far-fetched allusions, really fine and characteristic productions. The long poems called "A Treatise of Humane Learning," "A Treatise of Monarchie," and "A Treatise of Religion," are remarkable even for that wonderful age.

GREW'IA, a genus of plants of the order TILIACEÆ. Though the order takes its name from the European genus Tilia, its species are distributed chiefly through tropical countries. Grewia consists of sixty species of moderately sized trees or shrubs, which have leaves resembling those of the elm, yellow or purple flowers, and many of them pleasant tasted subacid fruit. They are natives of the warmer regions of the Old World.

The Tiliaceæ are noted for their mucilaginous properties, as well as for the remarkable tenacity of the inner fibre of their bark, as exemplified in the Tilia, or common European lime tree: that of *Grewia oppositifolia* is employed for making ropes and coarse cloth in the Himalayas. The wood of this tree is soft, elastic, and durable, and is used especially for the handles of tools; sandals are made from the bark, and also a fair paper. *Grewia elastica* is valued for the strength and elasticity of its wood. Cattle are fed on the leaves of some species, as *Grewia didyma*, at moderate elevations in the Himalayas; those of *Grewia oppositifolia* are said to give it its chief value, as they are used for fodder, and increase the quantity of milk. The pleasant-tasted subacid fruit of *Grewia elastica* and several other species is eaten by the natives of India, but principally used for flavouring sherbet. *Grewia asiatica* is that principally employed and cultivated in gardens. A decoction of the leaves of *Grewia polygama* has been found invaluable in fever and dysentery when quinine has failed. See *Journal of Linnean Society*, xx. 71. In Grewia there are five sepals coloured on the inside, and five petals, inserted at the base of the stalked ovary; the stamens are numerous and inserted at the top of the stalk of the ovary; the ovary has three or four cells.

GREY, CHARLES (second EARL GREY, K.G.), was born 13th March, 1764, at Falloden, near Alnwick, in

Northumberland. His father, Sir Charles Grey, was raised to the peerage in 1802 for his military services. Grey was returned in 1786 as a member for Northumberland. He attached himself to the party, and still more to the person, of Fox, and earned a high reputation as a speaker at a time when Fox, Burke, and Sheridan were at the height of their fame as orators.

Grey now took a prominent part in all the political questions that agitated the country during the disturbed state consequent on the French Revolution, both in the House of Commons and out of doors. He was one of the founders and most active members of the Society of the Friends of the People, formed for the purpose of obtaining a reform in Parliament, and on 6th May, 1793, he presented a petition from that society, which elaborately exposed the defects and evils of the existing system of parliamentary representation. In 1797 he presented a Reform Bill, providing for triennial Parliaments, household franchise, and redistribution of seats, which was defeated by 119 votes. He then withdrew from the House of Commons, or at least did not speak, until 1799, when he opposed the first propositions that were made for the union with Ireland.

The death of Pitt in 1806 led to the formation of a Whig ministry under Lord Grenville. Grey now became Lord Howick by his father's elevation, was appointed first lord of the admiralty, and Fox held the seals of the foreign office. On the death of Fox in September, the office which he had held was filled by Lord Howick, who met Parliament in December as leader of the House of Commons. He and Lord Grenville were now at the head of the Whig party. The cabinet was broken up in March, 1807, but during its brief existence Lord Howick had carried through the House of Commons the Act for the abolition of the slave trade. In November, 1807, on the death of his father, Lord Howick became Earl Grey, and he and Lord Grenville were the leaders of the Opposition in the House of Lords.

On the return of Napoleon from Elba, in 1815, Earl Grey was averse to hastily plunging into another war, and on this occasion he and Lord Grenville took opposite views. Earl Grey took an active part in the trial of Queen Caroline, and in opposing the Bill of Pains and Penalties which had been brought in against her. The Act for the emancipation of the Roman Catholics, which was passed in 1829, realized one of the great objects of his political life.

Up to 1830 the slightest measure of parliamentary reform had been resolutely denied; but when the Duke of Wellington's administration was compelled to resign, Earl Grey was sent for by William IV., and requested to form a new cabinet. On 1st March, 1831, Lord John Russell, as the organ of the cabinet, introduced the first Reform Bill into the House of Commons. The struggle is elsewhere told. [See REFORM BILL.] The cabinet was early shaken by some personal changes; in July, 1834, Earl Grey resigned, and in November the ministry were dismissed. Earl Grey died at his seat, Howick House, in Northumberland, 17th July, 1845. Two splendid achievements mark Grey's career, the abolition of slavery in 1807 and the passing of the great Reform Bill of 1832. His personal appearance was stately and commanding; his action graceful and animated; and his voice strong, flexible, and sonorous. As a speaker his style was pure and his manner free from affectation.

GREY, LADY JANE, born in 1537, was the great-grand-daughter of Henry VII. Henry's daughter Mary married Louis XII. of France, and on his death married Charles Brandon, duke of Suffolk. Their daughter, Frances Brandon, married Henry Grey, marquis of Dorset. Of this marriage Lady Jane Grey was the eldest daughter; there was no male issue. She was distinguished from childhood by her talents; and her acquirements were certainly, for her age, very unusual. She wrote, spoke, and understood Greek, Latin, French, and Italian, without for all that being unversed in the usual female accomplishments. She was also acquainted with Hebrew and with two other Oriental tongues. A marriage was concluded between Lady Jane Grey and Northumberland's fourth son, Lord Guildford Dudley, in May, 1553; and Edward VI., then at the point of death, was persuaded by Northumberland, entirely without Lady Jane Grey's knowledge, to set aside the rights of his sisters Mary and Elizabeth, and to settle the crown upon Lady Jane Grey. The king died 6th July; the attempt to secure the crown to her utterly failed, and ten days placed Mary in undisputed possession of the throne. Lady Jane, who had refused at first to profit by the plot, had only consented in view of Mary's known bigoted attachment to Roman Catholicism. She was at once seized, and with her husband confined in the Tower in the first instance; but after Wyatt's insurrection both were beheaded, 12th February, 1554. She addressed the people at her execution with great calmness and dignity, pleading truly that she had only done what she was forced to, but fully admitting the justice of her fate. She was scarcely seventeen.

GREY'HOUND is a variety of dog remarkable for keenness of sight, symmetrical strength and beauty of form, and great swiftness in the chase. It hunts its prey by keeping it in view, and not, like the foxhound, by scent. There are many breeds of this dog, of which the following are the principal:—The smooth-haired greyhound is very common in England, where it is used for hare-hunting or coursing. The points of this greyhound are well given in a rhyme quoted by Youatt:—

> "A Greyhounde shoulde be headed lyke a Snake,
> And neckyd lyke a Drake,
> Fotyd lyke a Cat,
> Tayled like a Ratte,
> Syded lyke a Teme,
> And chyned like a Bream."

The strength and courage of this dog have been sacrificed to speed. To supply the deficiency in courage, towards the close of the last century Lord Orford crossed his greyhounds with the bulldog. According to Youatt, after the sixth or seventh generation there was not a vestige left of the form of the bulldog, but his courage and indomitable perseverance remained. This cross is now usually adopted. The Irish greyhound is very large and powerful, and was formerly used for hunting wolves as long as any existed in Ireland. The Highland breed is the only kind possessing any power of scent; and the Italian greyhound is a very small and delicate variety, a pretty drawing-room pet. Greyhounds are not so domesticated as other dogs. The name greyhound has no reference to the normal colour; it is the Old English *grighund*, from the old word for dog.

GRI'AS, a genus of plants belonging to the order MYRTACEÆ. The species *Grias cauliflora* is the anchovy pear. It is a tall tree without branches; the leaves are 3 or 4 feet long and are clustered at the top, hanging down in a graceful manner, giving the tree a palm-like appearance. The flowers are large, and grow on very short stalks all down the trunk; they are of a yellow colour, and have a delightful perfume. It is a native of subalpine districts of Jamaica in boggy places. The fruit is an ovate berry the size of a goose's egg, is of a brownish-russet colour, and is pickled and eaten in the same way as the mango. It forms a handsome stove plant, especially when it flowers.

GRIB'BLE (*Limnoria terebrans*) is a crustacean belonging to the order ISOPODA. It is well-known for its destructive habit of boring into submersed timber. It is very small, seldom exceeding two-tenths of an inch in length; but it is gregarious, and very abundant in some situations. It is marine, and is generally found living in holes in wood, which it forms for itself. The ravages this little creature commits in the timber forming piers, dock-gates, &c., are very great. It was first described in 1811. The galleries

which it forms in the wood are tortuous, and run in all directions, though generally the animal bores upwards at an angle of about forty-five degrees. By being thus bored throughout its substance, the wood becomes so disintegrated that the sea washes away its surface, layer after layer, and the whole piece of timber is soon destroyed. The only wood it cannot destroy is teak.

GRIES'BACH, JOHANN JACOB, an eminent German scholar and critic of the New Testament, was born at Butzbach in Hesse-Darmstadt on the 4th of January, 1745, and died on the 24th of March, 1812. In 1769 he commenced a literary tour, in which he visited England and the principal libraries in Germany, Holland, and France. With a mass of valuable materials he returned in 1770 to Frankfurt, for the purpose of arranging them and applying them to the purpose of producing an amended text of the Christian Scriptures. The first edition of his critical emendation of the New Testament was published at Halle in 1794–95, 8vo, in three successive parts. Of the second edition the first volume appeared in 1796, and the second volume in 1807. This fine impression was made under the careful inspection of Griesbach. The other works of this scholar, which are numerous, are nearly all in Latin, and are all more or less directly devoted to the elucidation of biblical subjects.

Griesbach's text has been taken as a standard by numerous other editors. His marginal notes, forming a general and correct index to the great body of collated Greek manuscripts (about 500), are a treasure invaluable to the scholar and necessary to the divine.

GRIF'FON VULTURE (*Gyps fulvus*) or Tawny Vulture is a bird found all over Southern Europe, extending into North Africa and Central Asia; it has once been taken in the British Islands. The general colour of the plumage is tawny, deeper on the upper parts. The head and neck are clothed with a whitish down; there is a ruff of white feathers round the base of the neck. The beak is livid, with the tip blackish, and its base is enveloped in a flesh-coloured cere. The griffon vulture stands about 3½ feet high. Its nest is generally formed upon the most elevated and inaccessible rocks, but it often builds on the highest forest trees, and in Sardinia on the loftiest oaks, where the nest, of brushwood and roots, is more than 3 feet in diameter. The eggs are two or three in number, of a grayish-white colour, more or less covered with reddish spots. The griffon, like the rest of its family, feeds on carrion.

GRIMM, BARON, so well known to readers of Rousseau's "Confessions" as supplanting the philosopher in the good graces of Madame d'Epinay, and as in many other ways using the patronage which Rousseau procured for him at once for his own advancement and for the degradation of his generous friend, was of course by no means the heartless adventurer he is depicted in that immortal work. Friedrich Melchior Grimm was born at Regensburg in 1723. It is quite true that he was miserably poor in spite of his considerable powers and scholarship when Rousseau generously befriended him, found him work, and introduced him to Diderot and the other "Encyclopædists," and also to Madame d'Epinay. The rest comes of Rousseau's overwrought jealous fancy—"self-torturing sophist" as he was. Grimm quickly rose, being an accurate and diligent writer, a consummate critic, and a brilliant literary fencer. He hit upon the happy idea of a series of sheets or feuilletons, simply called "Feuilles de Grimm," many of which Diderot and other friends contributed, and which supplied German princes with a smart and readable account of all that was going on in French literature and philosophy. Diderot's matchless "Salons," reviewing the biennial exhibitions of pictures in Paris, appeared here. Grimm had been secretary to the Duke of Orleans, and in 1776 the Duke of Gotha, to whom he had been reader when he was but crown-prince, created him a baron and appointed him minister at the French court. At the Revolution he left France and gladly accepted the Russian ministry at Hamburg. Here he remained some years, removing to Gotha shortly before his death, which happened in 1807. The correspondence of Grimm and Diderot (Paris, 1829) is one of the finest critical works in French literature. It is perhaps hardly necessary to say that the weight lies chiefly on the side of Diderot. Grimm had the happy knack of turning literature to business account, a faculty in which so many of the philosophers were deficient.

GRIMM, JACOB LOUIS, one of the greatest linguists of modern times, was born at Hanau in 1785. He was educated at the Gymnasium of Cassel and the University of Marburg. In 1806 he was appointed secretary to the minister of war at Hesse-Cassel, and became successively librarian at Wilhelmshöhe and secretary to the Hessian ambassador at Paris. In 1830 he was made professor of literature and librarian of the University of Göttingen, which post he held for seven years. But when, in 1837, he signed the protest against the constitution introduced by King Ernest Augustus, he was deprived of his office and banished the kingdom. For some years he lived in retirement at Cassel, till in 1841 he was called to Berlin, where in the capacity of academician he resumed lecturing in the university. He sat as a member of the Frankfurt National Assembly in 1848. In all these offices Jacob Grimm proved himself a man of spotless integrity and honour, but it is chiefly for his philological and antiquarian works that he will be remembered. His "German Grammar," in four volumes, has laid the foundation for the historical knowledge of languages in general, and particularly the law of *Laut-verschiebung*, which he discovered. One must translate "Deutsche Grammatik" as "German Grammar," but the work is in fact a comparative grammar of Teutonic tongues, English being included among the rest. [See Grimm's Law.] His "History of the German Language," and book "On the Origin of Language," are also works of great importance. His other works are—"Antiquities of German Law," "German Mythology," numerous collections of Mährchen (or nursery and fireside stories), and the great dictionary of the German language, "Deutsches Wörterbuch," begun in 1852 and unfinished at his death, which occurred 20th September, 1863.

GRIMM, WILLIAM CHARLES, a distinguished German linguist, was born at Hanau, 24th February, 1786, and together with his brother (Jacob Louis just noticed) studied law at Marburg University. In 1814 he was appointed assistant-librarian at Cassel; in 1830, librarian; and in 1835, professor-extraordinary at Göttingen. In 1837 he protested against the constitution arbitrarily introduced by the King of Hanover, for which act he was outlawed, and obliged to retire to Cassel. In 1841 he joined his brother at Berlin, and laboured with him in the academy till his death in 1859. He edited a number of old German poems, wrote several learned treatises on German literature and antiquities, and materially assisted his more gifted brother in the publication of the "Mährchen" and the "Wörterbuch."

GRIMM'S LAW is the valuable discovery of Jacob Louis Grimm, the great philologer, which formulates the variation of consonants taking place as a word passes from one Indo-Germanic race to another. Thus if a Latin or Greek or Sanskrit word begins with a *p* the English edition of the same word has *f*. We have, Greek *pur*, English *fire;* Sanskrit *pitri*, Gr. *patér*, Lat. *pater*, Eng. *father;* Lat. *piscis*, Eng. *fish*, &c. Dividing consonants into *thin* (*p*, *t*, *k*), *medial* (*b*, *d*, *g*), and *aspirate* (*ph* or *f*, *th*, *ch* guttural, or *h*), we express the above by saying that a thin consonant in Greek and Latin becomes an aspirate in English.

Next we find that the aspirate in classical tongues corresponds to the medial in English; Gr. *ph*, Lat. *f*, answer to Eng. *b*. We have Gr. *phegos*, Lat. *fagus*, Eng. *beech*; Gr. *phratria*, Lat. *frater*, Eng. *brother*. Gr. *th* answers to Eng. *d* by the same rule; Gr. *thugatêr* is Eng. *daughter*.

Finally, where the classical tongues have the medial, English has the thin consonant. Thus we get Gr. *deka*, Lat. *decem*, Eng. *ten*; Gr. *duo*, Lat. *duo*, Eng. *two*, &c.

This connection is aptly remembered by connecting the Latin word *tam* with the German word *Amt*, the changes applying to German almost as well as to English:—

T A M
A M T

If we take any word that comes, say *father*, we should look for its Latin form not in *f* but in *p*, and we find there *penna*, i.e. *petna*, as the equivalent. That we have the real word in its Latin dress is shown by referring to the far more archaic Sanskrit, where *patra* is the form. As the Aryan or Indo-Germanic peoples split up, and each division settled down in every variety of climate and situation, it is very easy to see how these changes would slowly come about. Already our own cousins, the Americans, hardly a century old as a people, have a markedly peculiar tone and accent, almost amounting to a dialectic variety. In the introduction to the "Biglow Papers" a fine essay will be found, replete with Mr. Lowell's fancy and humour, but none the less accurate, on the peculiarities of Yankee or New England pronunciation. As yet the alteration is more upon the accent and the vowels than upon the consonants. We hear of *Euro'pean* and *Amur'ican*; but, as yet, from educated Americans we do not find the consonants perceptibly changing. However, there is quite sufficient even in these few years to show the way in which separation in space tends to cause separation in speech.

This illustration brings us to the second division of Grimm's law, the variation between the two great branches of the Teutonic division, High German and Low German. It is found that the High German sibilant, their nearest approach to a dental aspirate, is in Low German tongues a thin consonant. German zehn, English (one of the Low German tongues) *ten*. So also the High German medial and the Low German aspirate go together: German drei, English *three*, &c. And finally, the High German thin is the Low German medial: German Tochter, Eng. *daughter*; Ger. Tag, Eng. *day*. The formula is therefore f m t, answering to *tam*, or adding *a* to the first and *e* to the second to get a complete word in each language, we have

fa m t
t a me

The High German is itself a development, and the rule is therefore not clear in some other departments; the dentals, as is shown, follow it accurately, the labials *p b f* and the gutturals *k g ch* do not, however, usually follow it. To get at these we must go further back, to the Old High German, and here it is completely carried out. Thus Old High German Pruodar (Modern High German *bruder*), Gothic *brothar*, English *brother*, &c. The excellent formulæ given above are from Earle's "Philology of the English Tongue" (Clarendon Press, 1880).

GRIM'OALD or **GRIMALD, NICHOLAS,** one of the early Elizabethan poets (1519–62), was one of the chief contributors, perhaps the editor, of the famous "Tottel's Miscellany," which was issued by Tottel the publisher in 1557, the poems of Surrey and Wyatt first appearing in print in that collection, though previously known in MS. Surrey is the first writer of English blank verse, but his poems in that mode are translations; Grimoald's work in the Miscellany is original, and therefore he has the honour of being the first writer of original English blank verse. Grimoald also translated "Tully's Offices" (1556). He was a fellow of Merton College, Oxford.

GRIMSBY or **GREAT GRIMSBY,** a parliamentary and municipal borough and seaport in the county of Lincoln, is situated on the south bank of the Humber, near its mouth, 30 miles north-east of Lincoln, and 154 miles from London by the Great Northern Railway. The town consists of two parts. The older is irregularly laid out, and is at the head of the harbour; the new part, commonly called the Marsh, is regular and spacious, and extends along the east side of the harbour. It was of so much importance in the reign of Edward III. as to fit out ten ships for the siege of Calais. Owing to the blocking up of the harbour it was reduced to comparative insignificance, but after long decay trade has revived by the construction of convenient docks and the extension of railway communication. Legends attribute its foundation to a merchant named Gryme, who gained great riches by taking care of Havelock, an exposed child, who ultimately proved to be of the blood royal of Denmark.

The principal buildings are St. James' Church, in the Early English style, which was thoroughly restored and in a great measure rebuilt in 1859; other churches and chapels, a town-hall, a corn exchange, a custom-house, and grammar-school. The docks afford accommodation for more than 1200 ships, and are spacious enough to receive the largest men-of-war; there are likewise dry docks, ship yards, graving dock, and wharves and quays. The number of vessels registered as belonging to the port in 1884 was 720 (55,000 tons). The entries and clearances average 3600 (700,000 tons) per annum. The customs in 1883 was £107,690. The trade is good and rapidly increasing. Timber is one of the chief imports, and there is also considerable commerce in coal, grain, sugar, tobacco, and general produce. Grimsby has also an immense fishing trade, and there are several mills and factories. The Great Northern and the Manchester and Lincolnshire railways have stations. The town returns one member to Parliament. The population in 1881 was 45,351 (an increase of 19,000 from 1871), and the number of voters in 1884 was 7277. The municipal borough has 29,682 inhabitants. It is governed by eight aldermen and twenty-four councillors.

GRIN'DELWALD, a village and valley of Switzerland, in the canton and 36 miles south-east of Bern, in an Alpine valley, amid magnificent mountain scenery. It lies along the slopes of the Eiger, Mettenberg, and Wetterhorn mountains, between which are two enormous glaciers. The inhabitants rear cattle, and make large quantities of butter and cheese. The two glaciers, Upper and Lower Grindelwald, are the lowest in Switzerland, reaching a little over 3400 feet, the lower extremity sometimes advancing and then retiring again.

GRINDING, the act of smoothing a rough surface by rubbing with a hard substance or powder. Stone, marble, and plate-glass are polished by grinding together two pieces of the same substance with sand, emery, or other cutting powder. Grindstones are used for making the points of needles, pins, and forks, polishing gun-barrels, and finishing steel pens, &c. Another kind of grinding is that of crushing grain or other material into fine powder. In the flour-mill the wheat is ground between large rough stones.

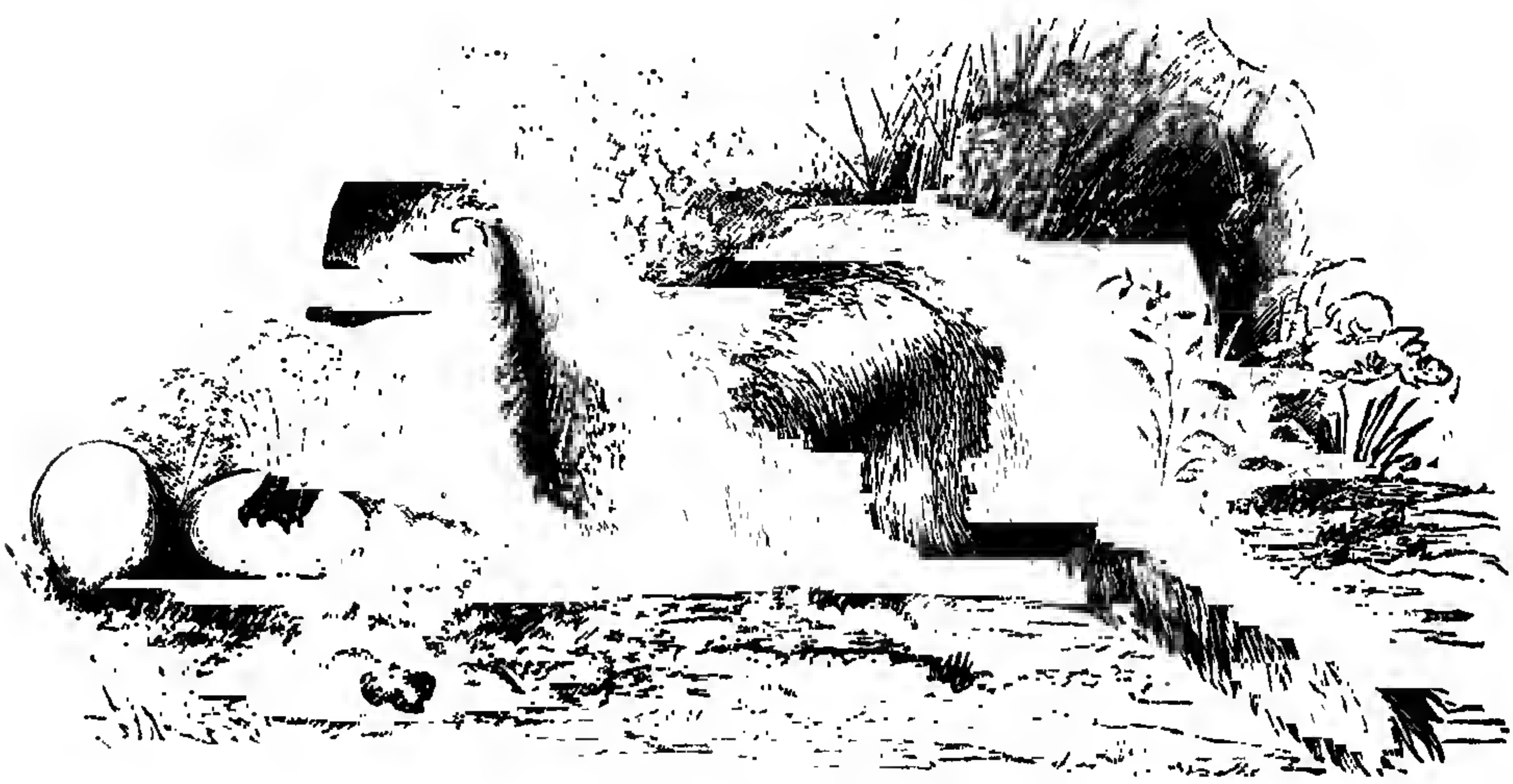
GRIPING or **GRIPES,** a name occasionally given to pains in the abdomen, whether brought about by the action of diarrhœa, constipation, or the action of purgatives. See CARMINATIVES, COLIC, FLATULENCE.

GRI'QUALAND WEST, an English colony in South Africa, which was proclaimed British territory in 1871. It is called Griqualand West to distinguish it from the eastern portion of Griqualand, which was annexed to the Cape of Good Hope in 1879. The population of Griqualand

West in 1881 was 49,101. The territory extends from the Orange River on the south to the Bechuana tribes and the Transvaal on the north and north-east. It stretches about 140 miles from north to south, and 180 from east to west, the area being about 17,800 square miles. The whole is reported good grazing country. Copper, lead, iron, and coal are all stated to have been found there, and there are rumours of auriferous quartz reefs; but little is known about these. It is in its diamonds that the wealth of Griqualand mainly consists. There are two descriptions of diggings—those on the banks of the Vaal River, where the diamonds are obtained by washing the gravel; and those called dry diggings, at which shafts are sunk through decomposed volcanic diamonds occurring chiefly in tufaceous limestone, clay, &c., which are dried and then sifted. The climate is salubrious, as the general elevation, from 3000 to 4000 feet above the sea, diminishes the temperature. The people known as Griquas are the descendants of Dutch colonists and Hottentot and Bush women.

GRI'SI, GIULIA, a very celebrated soprano operatic singer of the last generation, was born at Milan in 1810. Her mother and sisters were all accomplished singers, and the famous singer Grassini was her aunt. She early attracted the powerful interest of Rossini and the admiration of Bellini; and after singing in Italy for the second, she literally ran away to Paris to sing for the first. Thus commenced that long engagement at Paris which lasted from 1832 to 1849 without a break. She first appeared in London in 1834, and it was felt at once that the queen of the stage had reached her rightful throne. Summer after summer did Grisi sing in London, winter after winter in Paris. For many years Mario, Tamburini, and Lablache were her constant artistic companions. She eventually married Mario, and they had three daughters. Except for the year 1842 Grisi sang in London yearly for the surprising space of twenty-seven years—1834 to 1861. She accompanied Mario in a musical tour in the United States in 1854. Leaving the theatre in 1861, she nevertheless reappeared (unfortunately, as her old admirers thought) in 1866; but she soon left the stage for the platform. The English public, although her voice was now a mere wreck, bravely, as usual, supported an old favourite. She visited Berlin in 1869, and died there of a rather sudden attack of inflammation of the lungs.

GRI'SON (*Galictis vittata*), one of the weasel family (Mustelidæ), is a native of Guiana, Paraguay, and Brazil. The body is long and weasel-like, terminating in subplantigrade five-toed feet. The tail is of moderate length. The colour of the upper part of the head, body, and tail is lighter than that of the under parts; the former is brownish-gray, the latter brownish-black. The gray of the upper and the black of the under parts are separated by a broad band of a yellowish white colour, extending from the centre of the forehead above the eye backwards as far as the shoulder. The grison is nearly 3 feet in length, including the tail, which measures some 9 or 10 inches. It lives in holes in the earth or rocks, or in hollow trees. A tame



The Grison (*Galictis vittata*).

grison, which Bell had in his possession for several years, was very fond of frogs. She was also extremely fond of eggs, which she ate in a very singular manner. On one being given her, she first played with it for some time, running backwards and at the same time pushing it under her belly with her fore feet. At length she would fix one of her sharp canine teeth through the shell, and lick or suck as much of the contents as would flow through the orifice. Then, again inserting her tooth, a piece of the shell was broken out so as to enable her to insert her tongue; and finally, the egg-shell was broken to pieces and each fragment carefully licked clean. The genus Galictis also contains the Tayra (*Galictis barbara*), very similar in form and habits, but larger. The upper surface is white, the under black, and the band on the head white.

GRI'SONS, a canton of Switzerland, surrounded on every side by lofty mountains, except at one point on the north, through which the Rhine issues, and another on the east, by which the Inn escapes from the valley of Engadine on its way to join the Danube. A large offset of the Lepontian Alps detaches itself from the St. Gothard, and running N.E. marks the western boundary of the canton, dividing the waters of the Rhine from those of the Reuss and the Linth; it forms many high summits, covered with perpetual snow. The Rhætian Alps run east from the St. Gothard, dividing the feeders of the Rhine from those of the Ticino; the high summits, called Piz-val-Rhein (above 10,800 feet), Moschelhorn, and Adula, are in this range, over which pass the two roads of the Bernhardin and the Splugen, leading from the Grisons into Italy. East of the

Splugen, at the mountain called Maloya, the chain divides into two; one, continuing along the southern boundary of the Grisons, divides the feeders of the Adda from those of the Inn; and the other, running north-east, forms the watershed between the Inn and the Rhine. No less than 240 glaciers are reckoned within the limits of the Grisons. The area of the canton is 2963 square miles; its greatest length from east to west is about 80 miles, from north to south about 55. The population is 94,991, of whom 42,771 are Catholics. The proportion to the square mile is less than that of any other Swiss canton. On the frontier of Italy a dialect of Italian is spoken; in the rest of the canton the language is a dialect of German.

The surface is cut into a great number of valleys, the principal of which are the following:—1. The valley of the Vorder-Rhein, which rises at the foot of the Badus, and runs north-east to Coire. 2. The valley of the Hinter-Rhein, which rises south-east of the other, at the foot of the Piz-val-Rhein, and running north for about 40 miles, joins the Vorder-Rhein near Reichenau. The Splugen road runs along this valley. 3. The valley of Davos, or of the Albula, another affluent of the Rhine, issuing out of a small lake called Gross See, near the centre of the canton, and flowing first south-west and then west, joins the Hinter-Rhein near Tusis. 4. The Prättigau, or valley of the Lanquart, a stream that rises at the foot of the Piz-Linnard, in the chain which bounds the canton on the north, flows north-west for about 30 miles, and enters the Rhine near Mayenfeld. 5. The valley of ENGADINE. 6. The Münster Thal, a small valley east of Engadine, the waters of which flow into the Etsch or Adige. 7. The Val Poschiavo, south of Mount Bernina, the waters of which run into the Adda. 8. The Val Bregaglia, south of the Maloya and Septimer, through which flows the river Maira, on its way to join the Lake of Como. 9. Val Misocco, a considerable valley south of Mount Bernhardin, through which flows the Moesa, an affluent of the Ticino. 10. Val Calanca, west of Val Misocco, and the waters of which run into the Moesa. All these principal valleys give access to many smaller transverse valleys, some of them between 5000 and 6000 feet above the sea.

The productions of the soil are extremely varied, according to the elevation of the ground and the aspect of the respective valleys. Some enjoy almost an Italian climate, and the vine, wheat, maize, the fig, and the almond thrive in them, while others produce with difficulty scanty crops of barley and rye. Hemp and flax are cultivated, as well as potatoes, turnips, carrots, and other roots. A considerable part of the canton is occupied by pastures and forests. There are large numbers of cattle, sheep, goats, and pigs, but few horses. Cattle and cheese are exported to Italy. The mountains abound in game; there are also bears, wolves, lynxes, and wild-cats. Trout and salmon are found in the rivers.

The canton is a confederacy of small republics. The origin of the confederacy dates from the beginning of the fifteenth century, when the chief inhabitants of the valleys of the Upper Rhine, weary of the cruelties and oppressions of their feudal lords, assembled in a forest near the village of Trons, and there entered into a solemn compact to defend each other's property and persons, and to oblige their lords to respect the same. In May, 1424, they all repaired to the village of Trons, and there, under a large maple tree, swore, in the name of the Holy Trinity, to observe the conditions of the league, which was called the Gray League (Graubund), from their being dressed in gray smock-frocks. Two other leagues were subsequently formed, and the three leagues entered into a federal compact, and also formed an alliance with the Swiss cantons. In 1799 their country was devastated by the French, who drove away the Austrians, and were themselves driven away again by the Russians under Suwarrow. In 1803 the Grisons became a canton of the Helvetic Confederation. The Grisons was the country of the ancient Rhætii, who are thought by some to have been an Etruscan race.

GRIT or **GRITSTONE**, the term applied to certain coarse-grained and coherent sandstones. There are many varieties, according to the rocks from which the materials are derived, but as a rule quartz and similar hard crystalline substances predominate. In some cases where the materials are derived from disintegrated granite the resultant grit is simply a rearranged granite or *arkose*, composed of slightly abraded and rounded fragments of quartz, felspar, and mica.

GROAT, a silver coin or money of account equal to fourpence in England, but in Germany, Saxony, Bohemia, Poland, Holland, &c., of different values, under the different names of *groschen*, *groots*, *grots*, &c. The original Low German word *grote* still exists as the name of a coin of Bremen, one of the Free Cities of Germany. It simply is the word *great*, because the *grote* was larger than the old ordinary copper *schwaren* (heavy) in circulation there. The Bremen *grote* (or *groot*) is worth $\frac{1}{2}\frac{1}{0}$ of an English penny. The *silbergroschen*, or silver groat of the coinage of Germany, is equal to $1\frac{1}{5}$ penny. Before the reign of Edward III. no silver coin worth more than a penny was ever struck in England; but in 1351 the *grosses*, or great pieces, valued at fourpence, were issued [see a fine groat of Edward III. figured in COINS, Plate IV.]; and it was not until 1504 that shillings were coined—the groats, until then being the only silver coins in circulation. No fourpenny pieces have been coined since 1861—it being considered desirable to allow them to be gradually superseded by threepenny pieces.

GROATS or **GRITS** is the name given to the grain of oats from which the husk has been removed. The husk adheres so closely that millers are obliged to dry the grain first in a kiln, and when the husk is thus loosened it is removed by a process of milling.

GROD'NO, a government of Russia in Europe, between 51° 33′ and 54° 21′ N. lat., and between 22° 49′ and 26° 44′ E. lon., is composed of a portion of the grand-duchy of Lithuania and other eastern parts of Poland. It is bounded N. by Vilna, E. by Minsk, S. by Volhynia, and W. by the former kingdom of Poland, from which it is separated partially by the Bug, the Narev, the Bobra, and the Niemen. Its area is 14,961 square miles, and its population at the last census was 1,196,545. Its greatest length is 200 miles, and its greatest breadth about 140 miles. The surface is a wide plain, and it has numerous forests and marshes. The soil is in general favourable to the cultivation of grain and to the feeding of cattle. The greater part of the province belongs to the basin of the Niemen, which crosses it from N.E. to N.W., describing a vast curve and receiving numerous feeders from both banks. The south-east of the province contains vast swamps and several lakes; the river Yasiolda, a feeder of the Pripet, one of the principal affluents of the Dnieper, rises in this part. The Oginsky Canal, which joins the Yasiolda to the Lake Vititski, whence issues the Szczara, a navigable feeder of the Niemen, completes the communication between the DNIEPER and the Niemen. The south-west of the province belongs to the basin of the VISTULA, and is drained by the Bug and its tributaries from the right. The winter is very cold, and the climate damp and foggy.

Great quantities of barley, rye, oats, hops, hemp, and flax are produced. The crown holds a great number of the forests, which abound chiefly in pine. Horned cattle and sheep are numerous. Much wax and honey are made. The minerals consist of iron, limestone, clay, chalk, nitre, and saltpetre. Grodno is divided into nine districts. The manufactures are woollen cloths, hats, leather, paper, and spirits. There is a good export trade in grain, wool, cattle, and timber with Memel, Riga, and Königsberg.

GRODNO, the capital of the above province, stands on the right bank of the Niemen, 503 miles S.W. from St. Petersburg. It has 26,000 inhabitants, nearly three-fourths of whom are Jews. It is the seat of government for the province, and occupies a large extent of ground, but has neither walls nor gates. The palace erected by Augustus III., king of Poland, is handsome and regularly built, and opposite to the quadrangle in front of it is a fine building, containing the government offices. Grodno has Roman Catholic and United Greek Catholic churches, a Greek church, a Lutheran chapel, and synagogues. The Greek abbey of St. Basil is a handsome structure. There are some ruinous palaces, which formerly belonged to old Lithuanian families; a public library, a high school, a school of medicine, and several other seminaries. The chief manufactures are woollens, silks, and weapons. The trade is almost wholly in the hands of Jews. Large fairs are held three times a year. The Polish Diet held here in 1793 ratified the second partition of Poland. In 1795 the abdication of Stanislaus Augustus, the last king of Poland, was signed in Grodno.

GROG, a mixture of spirits and water. The name was given by sailors to the rum and water used by them as a beverage. Grog was a nickname of Admiral Vernon, who introduced the drink into the service. He was called Old Grog, from his habit of walking the deck in rough weather in a grogram cloak, and the name was transferred to the drink he introduced. According to recent regulations, those men in the navy who prefer to abstain from grog receive money, cocoa, coffee, or tea in lieu thereof.

GRON'INGEN, a province in the kingdom of the Netherlands, bounded N. by the German Ocean, E. by Hanover, S. by the province of Drenthe, and W. by Friesland. Its area is 885 miles, and its population in 1883 was 259,900. The whole province is a perfect level, intersected everywhere by canals and ditches, and protected from the sea by dykes. The principal rivers are the Hunze, which is navigable for large vessels from Groningen to its mouth in the Lauwer Zee; and the Aa, which runs into Dollart Bay. A great proportion of the land towards the south-east is marshy, but rich in pasture, which supports a fine breed of cattle and a great number of horses and sheep. The north of the province, however, contains the best soil, and is one of the most densely peopled districts of the kingdom. The soil is principally alluvial, and forms excellent arable land. A great quantity of turf is dug in the eastern part of the province. There are a few unimportant manufactures of woollen cloth, calico, hosiery, linen, and silk. Some of the population are engaged in the fisheries, but the bulk of the people are employed in husbandry and grazing.

GRONINGEN, the capital of the above province, is situated on the Hunze, at the influx of the Aa, 92 miles N.E. of Amsterdam, and is a large well-built town, with 48,986 inhabitants. It is the most important town in the northern part of the kingdom, nearly circular in its form, and surrounded by walls and a fosse. The great church of St. Martin, with a noble tower 343 feet high, the highest in Holland; the town-hall, a modern building in the market-place, the finest square in Holland; and the university are the most important structures in the town. There are also a public library, a botanic garden, an arsenal, and an institution for deaf-mutes, founded by Guyot, to whom a monument is erected in the Ossenmarkt. The harbour is good, and a considerable trade is carried on in butter, cheese, rape-seed, rape-oil, corn, cattle, and other agricultural products. The chief manufactures are of woollen and linen goods and paper, and there are several large shipbuilding yards. About 600 vessels of a large size visit the town annually. The great canal from the Ems to Harlingen, on the western coast of Friesland, passes through Groningen, from which another canal runs north-east through Appingadam, and terminates at Delfzyl in Dollart's Bay. Groningen is not mentioned previously to the ninth century, and it was not fortified for several ages afterwards. It was first attached to the United Provinces in 1576; it afterwards fell into the hands of the Spaniards, but was finally retaken by Prince Maurice in 1594.

GROOM, in old English, meant a servant in some mean station, a lad or lacquey who was sent on errands. At present, in common life, groom means a servant especially attendant on the stable. In higher life groom is the denomination of several officers or servants of the royal household, mostly in the lord chamberlain's department.

GROS'BEAK is a name given to several species of birds belonging to the family Fringillidæ, especially to the HAWFINCH (*Coccothraustes vulgaris*). The name has reference to the thick beak of the birds to which it is applied. The social grosbeaks belong to the family Ploceidæ (WEAVER-BIRDS).

GROS'SULARITE or **GROSSULAR GARNET** is the name applied to the lime-alumina garnets, which are of a pale green colour like a gooseberry, hence the name. Some mineralogists include the cinnamon stone with these.

GROSSWAR'DEIN, an ancient episcopal city of Hungary, capital of the county Bihar, on the Körös, 137 miles E.S.E. of Buda. Population, 29,000, mostly Roman Catholics. It consists of a fortress and eight suburbs, and has a cathedral, a large number of churches and other ecclesiastical buildings, a royal academy, gymnasium, a national and a Greek school. In the vicinity are several hot mineral springs. The town is connected by railway with Vienna. A great trade is carried on, especially in pottery, cattle-rearing, and the cultivation of the vine.

Grosswardein is one of the oldest towns of Hungary. The bishopric dates from early in the eleventh century. It was taken and pillaged by the Turks in 1660, and by the Austrians in 1692.

GROTE, GEORGE, one of the greatest literary ornaments of his time, descended from a family of German extraction, was grandson of a London banker. He was born in 1794 at Beckenham in Kent, and having been educated at the Charter-house entered his father's counting-house in the sixteenth year of his age. He, however, devoted his leisure hours to the study of the classics, became a profound Greek scholar, and when quite a young man made it one of the objects of his life to write a history of Greece. It was already known in 1823 that the young banker had begun the preparations for his work, which lasted till the period of the first Reform Bill, when they were interrupted for a time. That interruption was caused by the interest he took in the agitation for parliamentary reform, and was then still further hindered by his election to Parliament as one of the representatives for the city of London. On his withdrawal from public life in 1841 he again devoted himself to his labour; and in 1846 appeared the first two volumes of his celebrated "History of Greece." Although Mitford's work had by this time been superseded by the scholarly production of the Bishop of St. David's, the merits of Grote were speedily recognized, and the work became the standard "History of Greece," and may rightly be placed by the side of Gibbon's "Decline and Fall." The remaining volumes followed in rapid succession, volumes iii. and iv. in 1847, v. and vi. in 1849, vii. and viii. in 1850, ix. and x. in 1852, and the twelfth and concluding volume in 1856.

No sooner had Grote finished his *magnum opus* than he undertook to supplement one of the most celebrated chapters in it, that upon Socrates, by an exhaustive account of post-Socratic philosophy. The first three volumes of the new work appeared in 1865 under the title of "Plato and the other Companions of Sophocles." The

author was engaged at the time of his death upon an equally elaborate treatise on Aristotle, which was afterwards published under the editorship of Professors Bain and Croom-Robertson.

Mr. Grote was vice-chancellor of the University of London, and also a trustee of the British Museum; and when offered a peerage by Mr. Gladstone the veteran historian and philosopher declined to accept it, on the ground that he wished to spend all the time at his disposal in the discharge of his duties in the above offices. He was a member of the French Institute, and also of many foreign academies and learned societies. In 1820 he was married to Miss Harriet Lewin, the second daughter of a Kentish gentleman. By this lady, who is well known by her "Life of Ary Scheffer" and other excellent works, he left no issue. He died 18th June, 1871, and was interred in Westminster Abbey. Mrs. Grote wrote an excellent biography of her husband.

GRO'TIUS, HUGO, was born at Delft, 10th April, 1583, of which town his father, John de Groot, was burgomaster, and also curator of the then newly established University of Leyden. From his boyhood Grotius manifested an extraordinary ability. At the age of eleven he was sent to the University of Leyden, where his education was particularly superintended by the theologian Junius, with whom he lived, and by Joseph Scaliger. He remained three years at Leyden, during which he applied himself to the study of divinity, law, and mathematics. He was called to the bar, and pleaded with great success; but his legal occupations did not prevent him from attending to other studies. In 1599 he published a Latin translation of a nautical work, written by Stevinus, at the request of Prince Maurice of Nassau, for the use of naval officers. In 1600 appeared his edition of the "Phaenomena" of Aratus. He also cultivated poetry with such success that he was considered one of the best Latin poets of his time.

In 1607 he was nominated advocate-general for the treasury of Holland and Zeeland, and next year married Mary Reygersburg, a lady of one of the first families in Zeeland. In 1613 he was made pensionary of Rotterdam, a place which gave him a seat in the assembly of the States of Holland, and afterwards in that of the States-general; and about this time he formed a friendship with Olden Barneveldt. In 1615 Grotius was sent to England, in order to arrange the difficulties arising from the claims of the English to exclude the Dutch from the whale-fisheries of Greenland. The most agreeable incident of his visit to England was the opportunity which it gave him of forming an intimate friendship with Isaac Casaubon. The intimacy of Grotius with Barneveldt, whose political and religious opinions he shared, involved him in the misfortune of his friend. He was condemned, on the 18th of May, 1619, to perpetual imprisonment, and his property was confiscated. After eighteen months' confinement Grotius escaped by the contrivance of his wife, on the 21st of March, 1621. He made his way through Antwerp to France, where his wife, who had been detained for about a fortnight in prison, joined him a few months afterwards.

The Stadtholder Maurice dying, and his successor seeming less hostile to Grotius, he was induced by his Dutch friends to return. He arrived at Rotterdam in September, 1631, and the news of his return excited a great sensation. But in spite of all the efforts of his friends he was again obliged to leave the country, and went (in 1632) to Hamburg, where he lived till 1634, when he joined the Chancellor Oxenstiern at Frankfurt-on-the-Main, who appointed him councillor to the Queen of Sweden and her ambassador at the court of France. He was recalled at his own request, in 1644, and died in the following year. His last moments were spent in religious preparation. His body was carried to Delft and deposited in the grave of his ancestors, where a monument was erected to him in 1781.

The works of Grotius are very numerous. They treat of jurisprudence, divinity, history, literature, and poetry. Many of them have become classical. His "Opera Theologica," which were collected by his son Peter Grotius (four vols. 4to, Amsterdam, 1679), contain in the first volume his commentaries on the Holy Scriptures, but particularly on the Gospels. Leibnitz preferred Grotius to all the commentators. His chief work, "De Jure Belli et Pacis," was translated into all the European languages, and much light has been thrown on its plan and composition by the discovery of his "De Jure Prædæ" in 1868.

GROUND-ICE is the term applied to the ice that forms at the bottom of rivers and lakes under certain circumstances. It is of some importance as a geological transporting agent, for during its formation it often incloses pebbles and stones, which on the subsequent floating away of the ice are carried with it. This variety of ice is sometimes also known as *anchor* or *bottom ice.*

GROUND-IVY is a native of Europe and the north of Asia, in hedges and ditches, in woods and waste places, and is plentiful in Britain. The leaves of the ground-ivy were formerly thrown into the vat with ale, to clarify it and give it a flavour. This was called gill ale, ground-ivy being called gill or gell, and creep-by-ground in some places. Ground-ivy (*Nepeta glechoma*) belongs to the order LABIATÆ. The leaves are kidney-shaped, with a crenate margin; the stem is procumbent and creeping; the flowers are blue, occurring three or four together in a whorl. See NEPETA.

GROUND-MASS is the term used in petrology for the thoroughly crystalline aggregate of minutely formed minerals that constitutes the matrix of many porphyritic rocks; in them it surrounds the largely developed crystals, and generally forms the major portion of the rock. When examined microscopically this aggregate is found to be composed either of recognizable minerals, when it is termed microcrystalline; or if the compounds have no definite character, the ground-mass is said to be cryptocrystalline. In some porphyries the matrix is found to be a homogeneous, amorphous glass, when it is defined as a MAGMA.

GROUND-PIGEON is the name given to a group of birds, so classed either as a section of the great family Columbidæ (Pigeons) or as forming a distinct family, Gouridæ. In this group the bill is of the same form as in the true pigeons, which these birds resemble in their general characters; but they have the tarsi much elongated and considerably stouter, and their toes greatly resemble those of the game birds. The wings of the ground-pigeons are also short and rounded, indicating far less power of flight than is possessed by the pigeons generally; and, in fact, both in their structure and mode of life they may be regarded as forming a transition from the true pigeons to the true Gallinæ. These birds are found almost exclusively in the warmer parts of the world. Most of them are inhabitants of the eastern hemisphere, especially the Indian islands and Australia. The typical genus GOURA includes the magnificent crowned pigeon of the Malay Archipelago, the largest pigeon now living. The Nicobar Pigeon (*Calœnas nicobarica*) is remarkable for the splendour of its plumage, which is of a rich metallic green colour.

GROUND-RENT, a sum paid annually for the privilege of building on another man's ground. Land for building is usually let for a specified term, often ninety-nine years, the owner of the land being entitled to an annual ground-rent for the whole term. There are therefore two landlords, the freeholder and the leaseholder. The ground-landlord has the best security, as when his rent is in arrear he can distrain the furniture and effects found on the premises, whether belonging to the leaseholder or a tenant. If, to prevent seizure, the latter pays the ground-rent, he may deduct the sum from the next rent he pays. At the termination of the lease the building,

being a fixture, cannot be removed, and therefore becomes the property of the ground-landlord and his heirs. The falling in of ground-rents often creates a great accession of wealth. The system of feu-duty and ground-annual in Scotland is analogous to ground-rent, except that a feu is a perpetual lease, and the rent charged lasts for ever.

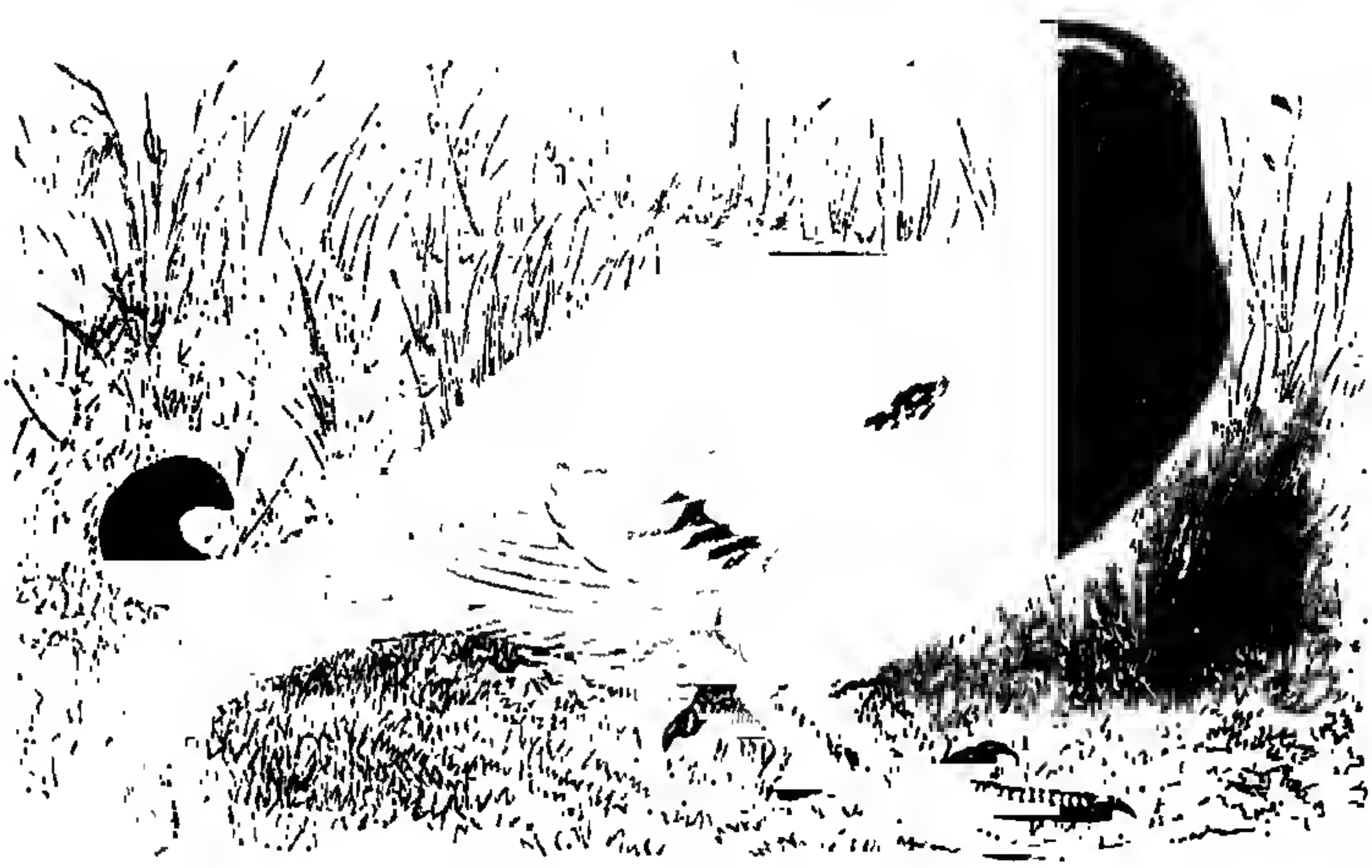
GROUND-ANNUAL, in Scotch law, a kind of estate intermediate between that of the superior and that of the vassal, and in the nature of a perpetual annuity out of land or house-property. It is often resorted to where subinfeudation is prohibited.

GROUND-SQUIRREL (Tamias) is a genus of SQUIRRELS (Sciuridæ) almost confined to North America, only one species (*Tamias asiaticus*) being found in North Europe and Asia. The ground-squirrels are distinguished from the true squirrels by the possession of large cheek pouches opening into the mouth. In general form and appearance they closely resemble the common tree-squirrels, except that the ears and tail are shorter; in their habits they are widely different, living in burrows in the ground. The Chipmunk (*Tamias striatus*) is well-known in the United States. It has a brownish-gray fur, marked with dark stripes, and becoming white beneath the belly. Including the tail it reaches a length of 10 inches. The chipmunk constructs a deep burrow, in which it stores up nuts, acorns, and seeds of all kinds; the corn crops suffer severely from the depredations of this little rodent. The burrow is somewhat complicated in structure. The hole descends almost perpendicularly for nearly a yard, and then makes several devious windings in a slightly ascending direction. Two or three supplementary galleries are driven from the principal burrow, and by means of them the animal is able to escape almost any foe. A large nest is constructed within the burrow, made of leaves and grass. These animals pass the winter within their burrows in a state of semitorpidity. Three other species of ground-squirrels, all with similar habits, are natives of North America.

GROUSE is the general name applied to species of the Tetraoninæ, a subfamily of the order GALLINÆ or game birds. This subfamily is united with the PARTRIDGES (Perdicinæ) to form the family TETRAONIDÆ. The chief difference between the grouse and the partridges is that the former have the legs feathered to the extremity of the tarsi, or even of the toes, while the partridges have naked scaled tarsi. The grouse have also the nostrils covered with small feathers.

The grouse are peculiar to the northern regions of both hemispheres, generally inhabiting the forests and moors and mountainous countries. Their food consists almost entirely of vegetable substances, such as seeds, fruits, and the young shoots of plants and trees.

The typical genus Tetrao contains the largest and finest birds of the group. The largest European species is the CAPERCAILZIE (*Tetrao urogallus*), a bird once indigenous in our islands, and now re-introduced into Scotland after its extirpation. The BLACK-COCK (*Tetrao tetrix*) still survives in many parts of England, and is even abundant in the Highlands of Scotland. The Pinnated Grouse (*Tetrao cupido*) of North America is about 19 inches in length, rather smaller than the black-cock; it is of a yellow-red colour, with black bars and other markings. Its most remarkable character consists in the presence in the male of a pair of curious wing-like tufts on the sides of the neck, each composed of about eighteen narrow feathers, of which the longest are 5 inches in length.



Black cock (*Tetrao tetrix.*)

Beneath each of these is a pendulous wrinkled fold of skin, which is capable of being inflated with air, and then resembles in bulk, colour, and shape a middle-sized orange. During the breeding season the male produces a curious call, which, from its resemblance to the distant sound of a horn, is called *tooting*, and is said to be audible at a distance of 3 or 4, or even 5 or 6 miles. At this period also the males are in the habit of assembling in some open glade about dawn, where they strut about and display themselves with extraordinary ostentation, occasionally varying these exercises by violent combats. Another American species of this genus is the Canadian Grouse (*Tetrao canadensis*). The genus Lagopus is distinguished by having the feet feathered down to the extremity of the toes. The Red Grouse (*Lagopus scoticus*) is peculiar to the British Islands, and is the species to which the name grouse is usually confined in this country. Though found both in England and Ireland it is most abundant in the Scotch Highlands. It inhabits the wild heaths and moors, and feeds upon the tender extremities of the branches of the heather, with cranberries, whortleberries, and other fruits and seeds. Unlike many of this group the red grouse pair, and the young when hatched are tended by both their parents. The female lays from eight to fifteen eggs in a nest formed of a few stems of heath and grass put together in a hollow of the ground; she lays very early in the spring, and sits very closely.

The red grouse is about 16 inches in length, and the

general colour of the plumage in the adult male is a fine rich reddish-brown, more or less marked with narrow transverse bars of black. The females are paler. Both sexes vary somewhat in colour at different seasons, but, unlike the nearly allied ptarmigan, the red grouse does not become white in winter.

The PTARMIGAN (*Lagopus mutus*) inhabits the more northern parts of Europe; in Britain it is not found further south than the mountains of Scotland. The Willow Grouse (*Lagopus albus*) is similar in plumage to the ptarmigan, putting on a white dress in winter. It is found in Northern Europe, Siberia, and North America, but does not occur in Britain. The genus Bonasia is represented in the northern parts of Europe and Asia by the Hazel Grouse or Gelinotte (*Bonasia betulina*); this bird does not occur in Britain. In North America a species of this genus occurs, the Ruffled Grouse (*Bonasia umbellus*). The ruffled grouse is solitary

Ruffled Grouse (*Bonasia umbellus*).

in its habits, being usually found singly or in pairs, occasionally in coveys of four or five. The female breeds in May, artfully concealing her nest, which contains from nine to fifteen eggs of a uniform dull yellowish or brownish-white colour. The ruffled grouse measures about 18 inches in length; there is a short crest on the top of the head; the shoulder-tufts consist each of about fifteen fan shaped feathers. The general colour of the male is chestnut-brown, mottled and undulated with blackish-brown and gray; shoulder-tufts velvet black, with green reflections. The female is paler tinted than the male, and the shoulder-tufts are orange brown.

GROVE'S BATTERY. See BATTERY.

GROW'AN (Old Cornish *gwren*, composition) is the term applied in geology to soft friable granite that has disintegrated *in situ*, owing to the alteration and decomposition of the felspar. The felspar is composed of silicates of alumina, potash, and soda; atmospheric water acting on these dissolves out the two latter with the formation of carbonates, leaving the insoluble silicate of alumina in a very fine condition as kaolin or China clay. The mica becomes slightly hydrated, but the quartz is unaffected. The composition of the felspar greatly affects the disintegration of the granite, some growans being quite unsuitable as China clays.

GROWLER (*Grystes salmonoides*) is a fish of the perch family (Percidæ), abundant in many of the rivers of the United States. This fish attains a length of 2 feet and is esteemed for the table. The body is oblong, covered with small scales. Only five conical teeth, arranged in a band, are present. The dorsal fin has ten spines, the anal three; the caudal fin is rounded. The name has reference to a sound emitted by the fish.

GRUB is a name applied to the larvæ of insects, especially of beetles; it is also sometimes given to insects in their pupal state. In the mouth of the farmer the word grub has a very limited sense, expressing the larvæ of the particular species of insect which is destroying his crop. See LARVA.

GRUB STREET, the name of a locality in London which has been rendered notorious in literary history as being the seat, not of "the immortal Nine," but of the meanest writers of ephemeral productions. The name of the place, and the contemptuous terms "Grub Street writers" and "Grub Street literature," are familiar to most readers, though perhaps the locality of the one or the origin of the other is known to comparatively few. Dr. Johnson, who considered the name of sufficient importance to insert in his celebrated dictionary, informs us that Grub Street was "originally the name of a street near Moorfields, in London, much inhabited by writers of small histories, dictionaries, and temporary poems; whence any mean production was called *Grub Street*." This street ran from Chiswell Street to Fore Street, between and parallel to Moor Lane and Whitecross Street; but the name has since been altered to Milton Street. It appears that Grub Street literature existed long anterior to the time of Johnson. From a work entitled "Memoirs of the Society of Grub Street," published in 1737, we learn that in the times of Charles I. there were a number of "literary guides, who, for the cheapness and obscurity of lodgings, resided in Grub Street, and from their garrets and cellars dispersed those false reports and reasonings, which were very instrumental in stirring up the people at last to a rebellion."

GRUBBER. See AGRICULTURAL IMPLEMENTS.

GRU'IDÆ. See CRANE.

GRUND MORAINE, or *Moraine Profonde*, is the name applied by Swiss geologists to infraglacial debris. Although represented to some extent beneath all glaciers, it is only beneath the ice sheets of the Arctic and Antarctic regions that it can be considered as typically developed. It is chiefly derived from the rocks beneath, being either torn off them by the moving mass or ground off by imprisoned blocks. It accumulates mostly in the large valleys beneath the ice, and consists of clay and stones, but where sub-glacial rivers flow sands and gravels are also produced. See GLACIERS.

GRUYÈRES or **GRUYÈRE,** a small town of Switzerland, in the canton of Fribourg, about 16 miles south-west of the town of Fribourg. It is celebrated for its cheese, which is largely imported into this country. The population of the town is only about 1200, but the cheese is made in the surrounding district.

GRYPHÆ'A is a genus of LAMELLIBRANCHIATA, belonging to the oyster family (Ostreidæ), and very abun-

Gryphæa incurva.

dant in the secondary strata of Europe from the lias upwards to the chalk. Of this genus of fossils a variety of species have been discovered in the lias, the greensand,

and the oolite formation of the earth's crust; as *Gryphæa columba*, a greensand species; *Gryphæa dilatata*, a middle oolite species; *Gryphæa virgula*, an upper oolite species, &c. But the *Gryphæa incurva* is a fossil peculiarly characteristic of the lower lias beds, which are called sometimes gryphite limestone in consequence. In this genus the left or lower valve (see cut) is much larger the right valve, which is concave; the beak of the lower valve is strongly incurved.

GRYS'BOC (*Antilope melanotis*) is a small African ANTELOPE common near Cape Colony. It is nearly 3 feet in length; the height at the shoulder is about 18 inches. The horns are about $3\frac{1}{2}$ inches long, the general colour of the fur of a deep chocolate red, and the ears are broad and rounded. The grysboc is found in pairs, more particularly among the wooded districts bordering the sea-coast. The females are hornless, and provided with only two mammæ.

GUA'CHARO BIRD (*Steatornis caripensis*). This singular bird was first introduced to science by Humboldt, who in his "Personal Narrative" gives a lively account of its locality and habits.

The genus Steatorn as formerly placed in the family Caprimulgidæ [see GOATSUCKER], but is now regarded as forming a distinct family, Steatornidæ. The characters of the genus of which this bird forms the only exam as follows:--Bill hard, horny, much wider than it is high, nearly equaling the head in length; upper mandible strongly bent downwards into a rather sharp hook, and armed near its middle with two small teeth; nostrils linear, longitudinal, nearly closed by a plate placed half way down the mandible; lower mandible rather slender, dilated at its base; gape considerable, and extending to the posterior part of the eye; base of the bill furnished with stiff hairs directed forwards; feet short, weak, with four toes separated up to their base; claws arched and weak, not dentilated; fourth quill longest.

The guacharo bird is thus described by Humboldt: Size of a common fowl; plumage sombre, brownish-gray, mixed with small striæ and black dots; large white heart-shaped spots, bordered with black on the plumage of the head and on the wing and tail feathers. The plumage of the back is without spots. Tail wedge shaped.

It was in the deep and romantic cavern which gives celebrity to the valley of Caripe in Cumana that Humboldt met with this strange bird. The *Cueva del Guacharo* is pierced in the vertical profile of a rock, and the entrance is towards the south, forming a vault 80 feet broad and 72 feet high. The rock which surmounts the cavern was covered with trees of gigantic height and all the luxuriant profusion of an intertropical vegetation. The travellers saw with astonishment plantain-leaved heliconias 18 feet in height, the praga palm, and tree-arums follow the banks of the river even to the subterranean places. There the vegetation continues, as in the deep crevices of the Andes, half shut out from the light of day, nor does it disappear till about thirty or forty paces distant from the entrance. The party went forward for about 430 feet without being obliged to light their torches. Where the light began to fail they heard from afar the hoarse cries of the guacharo birds. These birds quit the cavern only at nightfall, especially when there is moonlight; and Humboldt remarks that it is almost the only frugivorous nocturnal bird yet known. It feeds on very hard, oily fruits. He states that it is difficult to form an idea of the horrible noise made by thousands of these birds in the dark recesses of the cavern, whence their shrill and piercing cries strike upon the vaulted rocks, and are repeated by the echo in the depths of the grotto. By fixing torches of copal to the end of a long pole the Indians showed the nests of these birds 50 or 60 feet above the heads of the explorers, in funnel-shaped holes, with which the cavern roof is pierced like a sieve.

Once a year, near midsummer, the guacharo cavern is entered by the Indians, armed with poles for the destruction of all the young birds within reach. From the inside of these birds a very pure and delicate oil is procured by melting the fat in clay pots over a brushwood fire. It will keep above a year without becoming rancid. It appears that there are neighbouring caverns, too narrow to be accessible to man, inhabited by colonies of guacharo birds; and it is from these, perhaps, that the annual loss of numbers in the great cavern is supplied. Superstitious fears prevent the natives from proceeding far into the recesses of the cavern of Caripe. Hence, though thousands of young birds are destroyed, thousands escape, which is another circumstance tending to the preservation of this extraordinary species. This bird is also found in Trinidad and in several parts of South America. It is often called the Oil Bird by English writers.

GUA'CHOS, the country people inhabiting the pampas of the Argentine Republic. They call themselves whites, but from their intercourse with Indian women are now far from being of pure blood. They are engaged in rearing cattle, and lead an active life, but they are very rude and uncultivated. They are admirable horsemen, and throw the lasso, by which their live stock and the wild animals are captured, with unfailing precision. Their homesteads have generally a stockade, surrounded with a ditch and fenced with tall cacti, forming a formidable barrier to the hostile Indian.

GUADAGNI'NI, a family of Cremona violin makers, originating in two brothers, Lorenzo and John Baptist, natives of Piacenza, but resident at Cremona, pupils of Stradivari, working in the early part of the eighteenth century and for a few years before that. The violins of both of these are very highly esteemed. The second generation (middle of eighteenth century), Joseph and John Baptist, sons of the elder John Baptist, though good, is not comparable to the first in excellence. Succeeding generations merely traded upon the reputation of their ancestors.

GUADALAJA'RA or **GUADALAXA'RA,** a province of Spain, forming a part of the ancient division of New Castile. Its area is 4869 square miles, and its population 210,000. The chief town is Guadalajara, situated on the Henares, 34 miles E.N.E. of Madrid. The river is crossed by a bridge, partly of Roman architecture. Population, 8000.

GUADALAJA'RA, the capital of the state of Xalisco, and one of the handsomest towns in Mexico, is situated on the river Rio Grande de Santiago, about 21° N. lat., 104° W. lon., and has 80,000 inhabitants. The town is well built, the streets are straight, wide, airy, and many of the houses excellent. There are fourteen squares and several large convents and churches. The cathedral, the churches and convents of San Francesco and Sant Augustin, the university buildings, the house of congress, the Italian opera, the ecclesiastical seminary, and the mint are among its finest buildings. The portales or colonnades may be called the bazaar of the town, being filled with handsome shops well stocked with goods. The Alameda, or public walk, is well laid out; it has a fountain in the centre, and a stream of water all round. The climate is healthy, owing to the elevation of the town. The inhabitants are industrious, and carry on various trades. They are noted for their skill in working leather and in manufacturing a porous earthenware, with which they supply the neighbouring states. Shawls of striped calico are also made in considerable quantities. The city is supplied with water from numerous fountains, which are fed by an aqueduct 14 miles long.

GUA'DALQUIVIR (the ancient *Bætis* and the Arab *W'ad-al-Keber*) is the largest river in Spain. It rises near the eastern border of the province of Jaen, and drains nearly the whole of the district between the two ranges of

mountains; it receives the waters of the rivers Guadiana, Menor, Guadajez, Genil, &c., passing near Jaen, Cordova, and Seville. Its course is about 350 miles, and it is navigable below Seville. The general direction is south-west by west as far as Seville, where it takes a turn nearly south, and after forming two islands, Isla Mayor and Isla Menor, flows through a marshy and most unhealthy flat country into the Atlantic at San Lucar.

GUADELOUPE, one of the Lesser Antilles, belonging to France, lies about the point 16° 20′ N. lat., 62° W. lon. It is divided into two parts by a channel varying from 30 to 70 yards in breadth, and called La Rivière Salée, or Salt River, which runs from north to south, and has a large bay at each end. Its depth is so unequal that only vessels of small burden can pass through it. The land east of this channel is called Grande Terre, while that on the west is called Basse Terre. The entire length of the island is from 60 to 70 miles, and its greatest breadth is 25 miles. The area is 534 square miles, and the population 120,000, or with the dependencies 190,000. Three-fourths of the inhabitants were formerly slaves, but slavery was abolished by the French Republic in 1848. The island is the most important in the West Indies belonging to France. It is subdivided into three arrondissements and ruled by a governor and colonial council of French residents.

The island is apparently of volcanic origin. In the western division there is a mountain about 5500 feet high, called La Souffrière, or the Sulphur Hill, from which a thick black smoke rises, and which is sometimes an active volcano. It forms part of a ridge which extends through the western division, and gives rise to several streams. South-west of this mountain is a boiling spring issuing from out of the sea. Earthquakes are common; a very severe one occurred in 1843. Grande Terre is more level than the western side, but has no streams or springs, and the soil is less fertile. Sugar, molasses, rum, coffee, cotton, and cocoa are the chief products. A considerable quantity of fish is taken annually. The chief town is Basse Terre. Connected with Guadeloupe as dependencies are the neighbouring islets of Desirade, Marie Galante, Les Saintes, and the north part of St. Martin. The trade is almost exclusively with the mother country, but coals are imported from Great Britain. Guadeloupe was discovered by Columbus in 1493, but was not colonized by the French till the year 1635. After that it repeatedly fell into the hands of the English during the wars between England and France, but it was permanently ceded to the latter power in 1816.

GUADIA'NA, an important river of Spain and Portugal, its basin lying between those of the Tagus and Guadalquivir. It rises in La Mancha, 15 miles north-east of Villahermosa, flows at first west (and for some distance underground) through New Castile and Spanish Estremadura, then south through the Portuguese province of Alemtejo, and between Algarve and Andalusia, and enters the Mediterranean 13 miles east of Tavira, after a course of 380 miles, for the last 35 miles of which it is navigable. The area of its basin is 25,700 square miles.

GUAI'ACUM, a genus of small crooked trees, inhabiting several of the West India Islands, in low places near the sea, and belonging to the order ZYGOPHYLLEÆ. The most remarkable species is *Guaiacum officinale*, from which the hard, compact, black-green wood called lignum vitæ is obtained, which is so heavy that it sinks in water, and from which pestles, ship-blocks, rollers, castors, rulers, &c., are turned. It produces the gum-resin known in medicine under the name of Guaiacum.

Guaiacum officinale is a native of the West Indies, Colombia, and Venezuela. It is a tree of 20 or 30 feet in height, with round knotty branches and compound evergreen leaves, the leaflets being opposite in two or three pairs. The flowers are in clusters, of a pale blue colour, with orange anthers. For medicinal purposes the wood should be procured from heart-wood, being the richest in the active principle. It is very dense, heavier than water, of an obscure greenish-fawn colour; but the recent fracture is yellowish, exhibiting an unequal cleavage, with a fatty shiny appearance if the specimen be good. The sap-wood is lighter, both in colour and weight, pale fawn and opaque, and does not contain the valuable resin.

Genuine guaiac-wood is destitute of smell, but if rubbed, and still more if set on fire, it evolves an agreeable aromatic odour. If chewed the taste is acrid and somewhat aromatic. The wood is less used than the resin. Guaiac-resin exudes spontaneously, or in consequence of incisions, and hardens on the bark. Resin obtained in this way is generally in spherical or long tear-shaped pieces.

Guaiac possesses the property of stimulating the system generally, causing increased vascular action, augmented heat of the body, and promotes the secretions of the skin and lungs; but in large doses it produces nausea, anxiety, abdominal pains, and stupor. It is not prized now so highly as on its introduction into European practice in the sixteenth century, when it bore a most extravagant price, four ducats being often given for a pound of the wood. It is, however, a useful agent in certain forms and stages of gout and rheumatism, and in some cutaneous diseases, especially when, in the first set of disorders, it is combined with ammonia, and in the latter with mercurials and diaphoretics or antimonials.

Its insolubility in watery menstrua is an obstacle to its easy administration, and even its alcoholic solutions are precipitated on the addition of water. It is generally made into an emulsion, or given in pills; but a soap may be formed by means of heated aqua potassæ, in which the resin is to be dissolved, then evaporated, and a soft consistent mass is obtained, which may be formed into pills or a bolus.

GUAIARET'IC or **GUAIACIC ACID.** This is the principal constituent of the resin of guaiacum (*Guaiacum officinale*) or lignum vitæ, natural order Zygophylleæ. It is a crystalline acid occurring in colourless needles, soluble in alcohol and ether and in potash, but not in ammonia. Chloride of iron colours it green. It forms a series of salts called guaiaretates. When slowly distilled it yields guaiacol or pyroguaiacic acid, a colourless oil, and pyroguaiacin, a crystalline substance soluble in alcohol. Guaiaretic acid forms about nine-tenths of the resin which is largely used in medicine as an alterative.

GUAN' (Penelope) is a genus of game birds belonging to the CURASSOW family (Cracidæ). In this genus the bill is moderate, naked at the base, wider than high, convex above. Under the throat is a naked skin capable of being inflated. The nostrils are placed in the cere towards the middle of the bill, and half closed; the tarsi are long and slender. The Crested Guan (*Penelope cristata*) is about 30 inches in length. The upper parts are dusky black, or bronze glossed with green; a black stripe passes from the bill backwards and surrounds the ear; the fore part of the neck and breast is spotted with white; the lower part of the back and abdomen is reddish; the cheeks are naked, and of a violet purple; the bill is blackish; the head is crested with a tuft capable of being raised or depressed at will; the throat is furnished with a large scarlet pendent wattle capable of dilation. The plumage of the female is tinged with red. The guan is a native of Guiana and Brazil, where it inhabits the woods and is often seen in large bands; nevertheless, it is said to be monogamous, the males and females pairing together with the strictest constancy. It walks and runs with great ease and rapidity, but flies low and heavily. The nest is built on the branches of a tree, and the eggs are from three to five in number. All the birds of this genus appear to be known in Brazil by the name of *Jacu* (pronounced *Yacoo*), derived, according to

Marcgrave, from their loud and clamorous note, which, when uttered by numbers, makes the woods resound. A closely allied genus is Ortalida, presenting the same characters as those of Penelope, excepting that the head is completely feathered, and that there is no nakedness about the throat or round the eyes.

These two genera constitute a subfamily, Penelopinæ, of the family Cracidæ.

GUANAXUA'TO or **GUANAJUA'TO,** the capital of the state of Guanaxuato in Mexico, is situated on the table-land of Anahuac, near 21° N. lat., and 101° W. lon., at an elevation of 7200 feet above the level of the sea, on extremely uneven ground, furrowed by numerous ravines. The town, which owes its origin altogether to the gold and silver mines which surround it, is very irregularly built. Many of the streets are very steep. It contains numerous splendid memorials of the former rich produce of the surrounding mines in the magnificent palaces of the proprietors, in the church which formerly belonged to the Jesuits, in the numerous chapels and religious edifices, and in the road which leads to the mine of Valenciana, which has attained an immense depth. The Alhondiga, a large square building used as a public granary, is a solid-looking edifice. Guanaxuato is 160 miles north-west of Mexico. The population is 50,000. There are a mint and numerous mining works in the vicinity. Within 5 leagues north and south more than 100 shafts have been opened.

GUAN'INE, an organic base obtained from Peruvian guano, and found also in the excrements of the garden spider. It is a white amorphous powder, insoluble in water, alcohol, and ether. The formula is $C_5H_5N_5O$. The guano contains about a half per cent. of this base. Nitrous acid converts it into zanthine ($C_5H_4N_4O_2$). Guanine forms a number of crystalline salts in combination with acids. With strong nitric acid it forms nitroguanine.

GUAN'O (from the Peruvian word *huanu*, which signifies dung), a substance now very extensively used in agriculture, is the partially decomposed excrement of certain aquatic birds, chiefly the common penguin, which congregate in countless numbers on the barren and uninhabited islets and rocks on the western coasts of South America and the coasts of Africa. It abounds in ammonia and the phosphates, and is undoubtedly the richest natural manure known. Under judicious application the increase of the crops of grain, turnips, potatoes, and grass consequent upon its use is said to be about 33 per cent. Guano is particularly adapted to horticultural and floricultural improvement, by its relative cleanliness and facility of application. It appears to have been used as a manure long before Peru was visited by the Spaniards. It is spoken of by Herrera in a work published at Madrid in 1601; and by Garcilaso de la Vega in his "Memoriales Reales," published at Lisbon in 1609, who says that in the time of the Incas there was so much vigilance used in guarding these birds (the sea fowl) that during the rearing season no person was allowed to visit the islands which they frequented on pain of death, in order that they might not be frightened and driven away from their nests. Neither was it allowed to kill them at any time, either on or off the islands, under the same penalty. The German traveller Meyer, in his "Reise um die Welt," says: "Along almost the whole coast of Peru this excrementitious matter covers the small islands and cliffs near the coast, and on some spots lies in such enormous beds as could only be produced by the accumulation of thousands of years." About the commencement of 1843 guano was discovered on the island of Ichaboe, about 2½ miles from the mainland of Africa, in 26° 13′ S. lat., and 14° 15′ E. lon. The place soon attracted notice, and by the end of 1844 the whole of the guano had been carried away. As many as 350 ships were sometimes anchored off the island at the same time. The guano was from 35 to 38 feet deep, and the deposits extended to a length of about 1100 feet, with an average width of 400 feet. Towards the close of 1844 another guano island (Malagas) was discovered at the entrance of Saldanha Bay. The guano covered an extent of about 8 miles, and the thickness was from 4 to 8 yards. It has been supposed that the excrement of the sea-fowl which swarm on some parts of the coast of Great Britain might be used as a fertilizer with the same results as Peruvian or African guano; but the quantity which could be collected is comparatively small, as the animal accumulation is in most cases washed away by the rains, and the valuable properties of that which remains are dissipated by the changeable nature of our climate.

Peruvian guano was formerly obtained chiefly from the Chincha Islands, three in number, known as the North, Middle, and South Islands, distant about 12 miles from the coast of Peru and 90 from the port of Callao. They are of very small size, about 6 miles each in circumference, and since 1872 have been practically exhausted. Their deposits retained nearly the whole of their soluble constituents owing to the extreme dryness of the climate. Very large deposits also exist in the Guanape Islands, and have been worked since 1869; and in the Macabi Islands, situated 60 miles north of Guanape, off the port of Malabrigo. These were first worked in 1870. The province of Tarapaca was in 1874 found also to be specially rich in this valuable deposit, and large quantities have since been shipped from the Lobos Islands and the Ballestas group. There are, in fact, nearly fifty districts and islands under the Peruvian government in which guano is found. In 1874 the admiralty authorized Commander Cookson, of H.M.S. *Petrel*, to endeavour to effect some accurate measurements of the exact amount of guano remaining in these various places. With the courteous aid afforded by the Peruvian authorities this was accomplished, and the quantity of guano remaining in 1875 was estimated at about 10,060,000 tons, which at the price it generally fetches would be worth £130,000,000; but it is very much open to question if there really was anything like this quantity, it having been the interest of the Peruvian authorities to give the most favourable idea they could to Captain Cookson. An estimate made in 1877 only gave 2,000,000 tons as available for commerce. Since the earliest times in which the substance has been utilized as manure, a vast quantity has been exported.

The value of guano is to be estimated according to the proportions which it contains of—1, ammonia; 2, phosphates; 3, organic matter. African guano has the largest proportion of soluble matter, and that from Peru is remarkable for the quantity of uric acid that it contains, an element which dissolves very slowly. African guano may therefore act with greater rapidity, but the effect of Peruvian guano is felt for a longer period.

The quantity to be applied per acre may vary from 2 to 4 cwts., according to the nature and quality of the soil. It is best when rain follows the application of guano within a short time, and a wet season is generally considered most favourable to its success. The high price of guano has led to much adulteration, for which purpose umber, powdered stones, various earths, old mortar, and partially decomposed sawdust are employed. Many tests have been devised to detect the adulteration, the best being chemical ones, and the simplest its weight. A bushel of pure guano weighs from 56 to 60 lbs., and the lighter the better, provided on throwing it into water some of it floats. If heavier than 73 lbs. it has been adulterated.

GUARA'NA, the Brazilian cocoa, or bread-cake, is a heterogeneous mixture, consisting largely of the seeds of *Paullinia sorbilis*, and used like cocoa or tea for making a beverage. The cakes are mixed with water and sweetened in the same manner as we do those of chocolate or cocoa. Guarana contains a crystalline principle identical with

theine, which renders tea and coffee so valuable. There is a very large percentage of this principle, as much as from 4 to 5 per cent., while good black tea yields from 2 to 3·5, and coffee from 0·80 to 1·30 per cent.

The guarana plant is only known in Europe as small specimens in herbaria, but it is said to be a climbing plant with a smooth woody stem. The leaves are large, compound, with two pairs of leaflets and a terminal one. The fruit is about the size of a grape, with a thin, dry, tough skin, which splits into three valves. There is usually only one seed, about the size of a small hazel nut, and much like a horse-chestnut in colour and appearance. The name guarana is derived from the Guaranis, a Brazilian tribe.

GUARANTEE' is a contract binding a person to do some act in case of the failure of another person to fulfil that duty, who is himself liable in the first instance to the performance of the duty. Where a man borrows money, and another binds himself to see that it is repaid in due time, the contract is called a guarantee, and the person so binding himself a surety or guarantor. Also, when goods are supplied to a trader he has often to find a guarantor for the payment of the same. Credit is usually obtained for the first time in this way. The promise to answer for the debt, default, or miscarriage of any other person must be in writing, and signed by the party to be charged therewith, or some other person lawfully authorized by him.

A contract to guarantee the payment of any debt A. B. may contract in his business not exceeding £100, is a contract which renders the guarantor answerable for any debts not exceeding £100 which A. B. may from time to time contract in the way of his business. The surety, if he perform the contract, can sue the principal for reimbursement.

GUARA'PO, the name of an intoxicating beverage made from the juice of the sugar-cane, and chiefly drunk by the negroes and lower orders in South America. Like the sap of the palm-tree, that of the sugar cane ferments spontaneously; and the liquor contains all the ingredients of the cane juice, except those which disappear during the process of fermentation.

GUARDIAN is the name given in English law to one who has the legal control or management of the person or property, or both, of an infant, *i.e.* a person under the age of twenty-one. Several kinds of guardianship are distinguished in law, the most common being such as one by nature, for nurture, testamentary or by statute, and judicial or by appointment of chancery.

Guardian by Nature is a term used to describe the parent of a child, and this species of guardianship has no connection with tenure. Any ancestor of the infant may be such a guardian, the first right being in the father, the next in the mother, and, if they be dead, the ancestor to whom the infant is heir has a right to the custody of his person.

Guardian for Nurture is the name given to that exercised by the father of an infant, or if he be dead to the mother, who as such has the custody and control of the children until they reach the age of fourteen.

Guardians by Statute.—Fathers may, by deed or will attested by two witnesses, appoint any person or persons guardians of their unmarried children until the twenty-first anniversary of their birthday. A guardian appointed under statute supersedes all other guardians, except such as exist by the custom of any city or corporate town, in favour of which an exception is made by the Act regulating the law on this subject, and is entitled to the custody of the infant's person and his property. Where two or more persons are appointed guardians by statute the guardianship remains to the survivor.

The duties of the guardian to his ward are similar to those of a parent to his child, and there is a corresponding obligation on the part of the ward to the guardian. On the coming of age of the ward the guardian is responsible to him, and must give an account of all transactions on his behalf, the guardian being responsible for any loss that has arisen by reason of his wilful default or negligence.

Judicial Guardians.—Where an infant is without a guardian the Chancery Division of the High Court has power to appoint one, and the infant then becomes a ward of court. Where a proper case exists for the jurisdiction of this court, it will interfere not only with the property of the infant, but also with the custody of his person, and will in case of any misbehaviour remove a guardian however he may have been appointed or constituted, and will appoint a proper guardian to the infant in his room. Thus the court has power to set aside even the guardianship of parents should it judge them to be unfit to take care of the infant. A ward of court requires the sanction of the guardian for most purposes, and requires the permission of the court to marry. Any person who marries a ward, whether male or female, without the permission of the court, or is wilfully instrumental in bringing about such a marriage, is liable to the censure of the court, and may be committed for contempt. Where a man marries a ward without the consent of the court the law gives him no control over her property, which may be exclusively settled upon the ward and her children or otherwise, as the court may consider advisable. Ignorance of the wardship cannot be pleaded as a sufficient excuse, but may be taken into consideration by the court.

Guardian ad Litem is the name given to a person appointed by the Chancery Division to carry on a suit in the name of an infant. The father, if living, is usually appointed to this office. Guardians are provided by the law of England for lunatics and idiots, but such persons are technically termed *committees*, and the rules relating to them will be more conveniently considered under LUNATIC. In the Roman system the terms tutor and curator correspond in some degree to the English guardian.

In Scotland, following the Roman law, the guardian of a pupil—that is, a child under fourteen years if a male and twelve if a female—is termed a tutor. The father is the proper tutor; but on his death that office falls to such person or persons as he may have nominated by any writing under his hand, and these are termed "tutors-nominate." In default of a tutor-nominate a "tutor-at-law," termed also *tutor legitim*, is appointed by judicial authority, and is the nearest male agnate of common understanding and prn id 1 -fiv of : who [illegible] rity *rem pupilli salvam fore*, and is willing to undertake the office. In default of both tutors-nominate and tutors-at-law a "tutor dative" may be appointed by the sovereign as *pater patriæ*. The procedure takes place in the Court of Session. When a pupil has no tutor at all a *factor loco tutoris* will also be appointed by that court. When young persons attain the age of puberty—fourteen in males and twelve in females—they are styled "minors" till they attain the age of twenty-one. To them the father while alive is the proper guardian or "curator," unless he is superseded by the marriage of a female minor, whose husband is thenceforth her proper curator, or unless the minor, with his father's consent, choose other curators, or the father's office of administrator at law is excluded in relation to property left to the minor under other administrators. When the minor has claims against his father a *curator ad litem* may be appointed to him. Where the father has died without naming curators the minor may elect to act without guardians, or he may obtain curators appointed to him by certain procedure before the judge-ordinary. Such curators must find security. Curators are also appointed to idiots and insane persons, and they are those who in the case of minors would be entitled to the office. In modern practice it is usual to apply to the Court of Session for the appointment of a *curator bonis*, which will be granted on production of medical certificates of insanity. *Curators bonis* are

also appointed when a person is labouring under some temporary incapacity to manage his own affairs—such as absence from the country. A *curator ad litem* is appointed when a wife is engaged in a lawsuit with her husband, or a minor with his curators, or indeed with anyone, and has no proper guardians. The appointment is made by the judge before whom the action depends, on the motion of either party; for if this is not done any decree against the minor may be opened up as a decree in absence.

GUARDIAN OF THE POOR. See POOR LAW.

GUARDS, in military affairs, are such bodies of men as are appointed to secure the army or any place from surprise, and for this purpose there are various kinds of guards, as the main-guard, van-guard, rear-guard, baggage-guard, mounted-guard, &c. But in a special sense the term more immediately applies to the brigade of household troops, whose duty is to protect the person of the sovereign, and to certain regiments which form the élite of the army. In the British army there are three regiments of foot and three of horse guards. The infantry regiments are the Grenadier Guards, Coldstream Guards, and the Scots Fusilier Guards; while the cavalry are the 1st and 2nd Life Guards and Royal Horse Guards (Blue). The Guards in time of peace constitute a part of the garrison of London and the guard of the sovereign at Windsor, and they do not leave the country unless their services are specially required abroad. Under the purchase system in the army commissions in these regiments cost more than in others; but the pay was higher, and a grade of superior army rank accompanied each regimental commission—lieutenants ranking as captains, colonels as generals, &c. On the abolition of purchase in 1871, this exceptional rank was abolished in respect to all commissions granted after that date.

GUARD-SHIP is the man-of-war in charge of a port. It is also used as a depot for naval recruits until they are attached to other vessels. The captain of a guard-ship is responsible for the safety of all the war-ships laid up out of use in the harbour.

GUARNE'RIUS (Ital. *Guarnieri*) is the Latinized name of a famous family of Cremona violin-makers. The founder, Andrew Guarnieri, learned his art from Nicholas Amati, and was bench-fellow with Stradivari. His son Joseph, called *Joseph filius Andreæ* (Joseph, son of Andrew), and his grandson, Joseph's son Peter, called Peter of Venice for distinction, are also excellent makers, of the true Cremona tradition. A brother of Joseph, called Peter of Cremona, is also a remarkably fine maker, as was his nephew, Peter of Venice.

The "great Joseph," or *Joseph del Gesù*, was a nephew of Andrew, first of the family, and a pupil of Joseph, son of Andrew. He struck out a third pattern, frequently of massive dimensions, and of wonderful sonority of tone—quite original, and frequently deviated from in parts, in quest of further originality. A large number of his violins have a mark in the grain of the wood so peculiar that they are evidently taken from the same block of wood, and to the remarkable vibratory excellence of this precious piece of timber connoisseurs are disposed to attribute the splendid triumphs of the "great Joseph." The nickname *del Gesù* is from a frequent habit of his to sign "Joseph Guarnerius, I.H.S.," the three letters being taken to mean the sacred monogram of Jesus.

GUATEMA'LA, one of the republics of Central America, formerly a part of the Mexican Confederation, but erected into a separate state in 1847. It is bounded on the N. by Yucatan and Mexico, on the E. by Honduras and San Salvador, and on the S. by the Pacific Ocean. The area is about 40,000 square miles, and the population is estimated at about 1,220,000. The physical features of the country are mountainous throughout, and a mountain chain, generally considered a continuation of the Andes, traverses the central parts of the country, thus forming a kind of chain of communication between the Cordilleras of South America and the mountain chains of Mexico. The mountains rise much more precipitously from the side of the Pacific than the Atlantic, the general slope of the country being to the north-east, with an average height of about 7000 feet above the ocean; the loftiest summits, which are either active or extinct volcanoes, being in that part of the confederation. The Water Volcano, near Guatemala, so called from its having destroyed the town of Old Guatemala in 1541 by water, is 13,108 feet above the Pacific. There are two large plains—those of Nicaragua and Comayagua, besides many of less size on the banks of the larger rivers and along the shores; these principally consist of extensive savannahs with rich pasturage interspersed with clumps of trees. All the larger rivers flow north-east or east, the proximity of the high mountain range to the Pacific permitting but a short course to those flowing west. The Montagua is of considerable size, and useful for the conveyance of European and other goods into the interior of Guatemala. The principal lakes are the Golfo-Dolce, and those of Leon or Managua, Peten, Atitan, and Amatitan. The Golfo-Dolce, 27 miles long by 12 broad, receives several rivers, and discharges itself by the Rio Dolce into the Bay of Honduras.

The coast plains are subject to violent tropical heats, and are very unhealthy, especially those on the east coast, on the Caribbean Sea, where fevers incessantly prevail. Earthquakes are very frequent. The forests yield many valuable kinds of timber, including mahogany, cedar, *palo di maria*, a species of wood well adapted for shipbuilding, &c. But the logwood tree (*Hæmatoxylon Campeachianum*, Linn.) is by far the most valuable of the products of the forests. It is found here and in the adjoining peninsula of Yucatan in the greatest perfection, and is a most important article of export; a species of Brazil-wood is also exported. Among the other vegetable products may be enumerated the dragon's blood, mastic, *palma Christi*, and other balsamic, aromatic, and medicinal plants; with the sugar-cane, cocoa, cochineal, indigo, coffee, tobacco, and cotton, which are extensively cultivated.

Guatemala is divided into twenty departments. It is governed by a president and a council of state of twenty-four members, elected by the house of representatives. The latter is elected by the people, and consists of fifty-two members. The Roman Catholic is the established religion, but complete religious toleration exists.

History.—The north-east coast of Guatemala was discovered by Columbus in 1502. Most of it was conquered by the Spaniards about 1524, and erected into a captain-generalship by the Emperor Charles V. in 1527. The policy adopted by Spain towards Guatemala was attended with unintentional benefits to the latter. Being only a captain-generalship the scale of its public expenditure was kept down in deference to the higher pretensions of the Spanish viceroyalties, and as its financial wants were few, taxation pressed lightly on the people. It was not, however, permitted to export more of its native products than were sufficient to pay for the articles which the merchants of Cadiz thought necessary to send for its consumption. Guatemala, together with the other states of Central America, became independent in 1821, and was subsequently incorporated with Mexico. The Mexican Confederation was again broken up in 1823, and the Central American states formed a league by themselves in 1842. From this union Guatemala seceded 21st March, 1847, and has since continued a separate state, and a conference which met in 1876 to consider a new alliance terminated without success.

GUATEMALA LA NUEVA, or NEW GUATEMALA, the capital of the above republic, is situated on a plain, which is about 11 miles long, 9 wide, and 4372 feet above the sea-level; it is 120 miles from the Atlantic and 50 from the

Pacific. Population, about 60,000. It is built with great regularity. The streets are straight, and slope from each side towards the middle, where a stream of water runs. The houses have generally only one storey, but occupy a great deal of ground, containing within their walls one, two, or even three courtyards. The town is well provided with water brought by an aqueduct from a spring about 4 miles distant. The most remarkable buildings are round the market-place, which is situated nearly in the centre of the town. On three sides of it are projecting piazzas, which form a covered walk, under which various articles exposed for sale. On the east side stands the cathedral, a simple but noble building, and near it the palace of the archbishop and the university. There are numerous churches. The town is the seat of an archbishop and of the government authorities; it has a mint, university, two colleges, an hospital, barracks, a public library, and several other literary and scientific institutions. Guatemala enjoys perpetual spring. The thermometer rarely rises above 80°, and still more rarely descends below 60°. Earthquakes are frequent. New Guatemala has a flourishing trade with Vera Cruz, Mexico, &c., in sugar, cotton, coffee, dyewoods, and other native products. The inhabitants produce muslins, fine cotton yarn, silver articles, artificial flowers, and embroidery of high excellence.

Guatemala la Antigua, or Old Guatemala, which is about 26 miles W.S.W. of the capital, is situated in a wide valley of great fertility, at the western end of which rise the two volcanoes of De Agua and De Fuego, each about 13,000 feet high. The town itself is at an elevation of 5817 feet. After its partial destruction in 1773, and the foundation of New Guatemala, the Spanish government ordered the place to be abandoned. But as a considerable portion of the town had not suffered, people still returned to it, and the population is now nearly 30,000. Considerable damage was again inflicted by an earthquake in 1874. Among the buildings which were not destroyed are the cathedral and the town-hall, the latter a magnificent edifice and a sample of the style in which the place was built. The town has lately made great progress since the introduction of cochineal cultivation.

GUA'VA, the fruit of *Psidium Guayava*, belonging to the order Myrtaceæ. The guava tree is only from 15 to 20 feet high; the leaves are oblong with prominent veins, and downy underneath; the flowers are large and of a white colour; the fruit is about the size of a hen's egg; it has a thin rind inclosing a firm pulp, divided into several cells, each containing numerous seeds. There are two principal varieties, *pomiferum*, with rounded fruits, and *pyriferum*, with pear-shaped fruits. The former is considered by De Candolle to be the original species; it has a bright yellow rind, a red fleshy pulp, of a pleasantly acid taste. The variety *pyriferum* is probably due to culture; its pulp is of a yellowish tinge, and it is called the white guava, in contrast with the red guava. It has a finer flavour than the other, and is liked better for eating. Both kinds are used for making guava jelly and guava cheese. De Candolle considers that this species is a native of Mexico, Colombia, and Peru; that it had spread to Brazil before the discovery of America, and to the Antilles after that event. Gradually the culture has spread throughout the West Indies, and to all tropical countries. Tennent speaks of the guava as well established in the jungles in Ceylon. It grows well in hothouses in this country.

The Purple Guava (*Psidium variabile*, Berg.) was introduced into Europe from China, but there is no doubt that it originally came from Brazil. It has pitted rind of a claret colour; the flesh is reddish outwards, becoming gradually white towards the centre.

GUAYAQUIL', the capital of the department of Guayaquil, in the republic of Ecuador in South America, is situated in about 2° 12′ S. lat., 79° 50′ W. lon., on the river Guayaquil, which is about 2 miles wide opposite the town, and enters the sea 40 miles below it, near the island of Puna. Vessels of considerable burden can sail up to the town, as the tide at full and change rises 24 feet; and the trading facilities of the port have been much improved by the erection of lights, buoys, &c. The whole town, which is very unhealthy during the rainy season (from December to April), malignant fevers being then very prevalent, extends about 2 miles along the northern side of the river, but its breadth is inconsiderable. Shocks of earthquakes are often experienced here. The principal buildings are the cathedral, two hospitals, and two colleges, the last of which have faculties of theology, philosophy, and law. Important works have greatly improved the water supply and drainage, and great improvements have been made in the communications with Quito and other large towns. The town has the best harbour on the Pacific shores of South America; and European goods, chiefly fine cottons, woollens, silks, liquors, groceries, soap, metals, and flour are imported, and sent up the river to Caracol, and from thence to Quito. The exports from Guayaquil are cocoa, straw-hats, timber, bark, hides, orchilla, tobacco, sarsaparilla, canes, india-rubber, and coffee.

GUAZU'MA is a genus of plants belonging to the Buettneriee, a tribe of the order Sterculiaceæ. It is nearly allied to Theobroma, which produces cocoa, but differs in the fruit, which is capsular, opening by valves, more like the horse-chestnut; whereas the cocoa fruit is fleshy, with the seeds imbedded in pulp.

Guazuma tomentosa is a native of tropical America, and is also found in Java and India; but it is doubtful whether it is a native of Asia, as four species out of the five which compose the genus are certainly American. In the West Indies and India it is known as bastard cedar. The wood is light and loose-grained, and is useful for making articles of furniture. The tree grows quickly, attaining in India a height of from 40 to 60 feet, double and treble its height in the West Indies. Its leaves are like those of the elm, hence the French colonists in the West Indies have named it Orme d'Amerique. The whole of the tree, bark, leaves, and fruit, are full of a mucilaginous sap, which is not only agreeable to the taste, but is also considered efficacious in various diseases. A decoction of the bark is given in elephantiasis, and was formerly much used in the West Indies as a substitute for albumen to clarify cane-juice in the manufacture of sugar. Roxburgh tested the strength of the fibre prepared from the young shoots, and found that it required as much as 100 lbs. to break it when dry, and 140 lbs. when wet. The leaves, and even the fruit, afford good fodder for cattle. As the trees grow rapidly and look well, they are much planted for the purpose of forming avenues.

GUD'GEON (*Gobio fluviatilis*) is a small fish common in many of the rivers and running streams of this country, and also in most other parts of Europe. It is generally about 5 or 6 inches in length. The upper parts of the head and body are of an olive-brown colour spotted with black, and the under parts are white. The dorsal fin and the tail are brownish, and spotted with a deeper colour. The gudgeon is found in shoals most abundantly in streams with gravelly bottoms. It bites very freely, especially at the small red worm. This fish, though small, is much esteemed for the table.

The gudgeon belongs to the family Cyprinidæ and genus Gobio, which latter differs chiefly from the genus Barbus (the barbels) in having no strong bony ray at the commencement of either the dorsal or anal fins. Like the barbels, the gudgeons have both the dorsal and anal fins short, and are furnished with small barbels about the mouth. There are two rows of pharyngeal teeth, which are hooked. Beside the common gudgeon only one other species is known, *Gobio uranoscopus*, peculiar to Austria.

GUE'BRES, the name given by the Mohammedans to the surviving adherents of the old Persian religion which was formulated by Zoroaster. When the all-conquering advance of the Arabs caused the downfall of the Sassanian dynasty the majority of the Persians submitted to their new rulers and accepted the religion of Islam, but a few who clung to their old faith fled to the mountains of Khorassan, or to the island of Hormuz. A few after various migrations found a home in India, where they became known as Parsees; but the majority, who remained in Khorassan, were for centuries subjected to constant oppression from the Mohammedans. They are now chiefly confined to the cities of Yezd and Kirman and some twenty villages in their neighbourhood, their numbers being estimated at 7000 or 8000. A few may be found at Baku, in the neighbourhood of the naphtha springs, and a few also in some of the larger cities of Persia; but for the most part they are plunged in extreme poverty and ignorance, and are regarded with dislike by their neighbours. They bear a good character, however, for honesty, chastity, and endurance, and they seem to be a peaceable and law-abiding people.

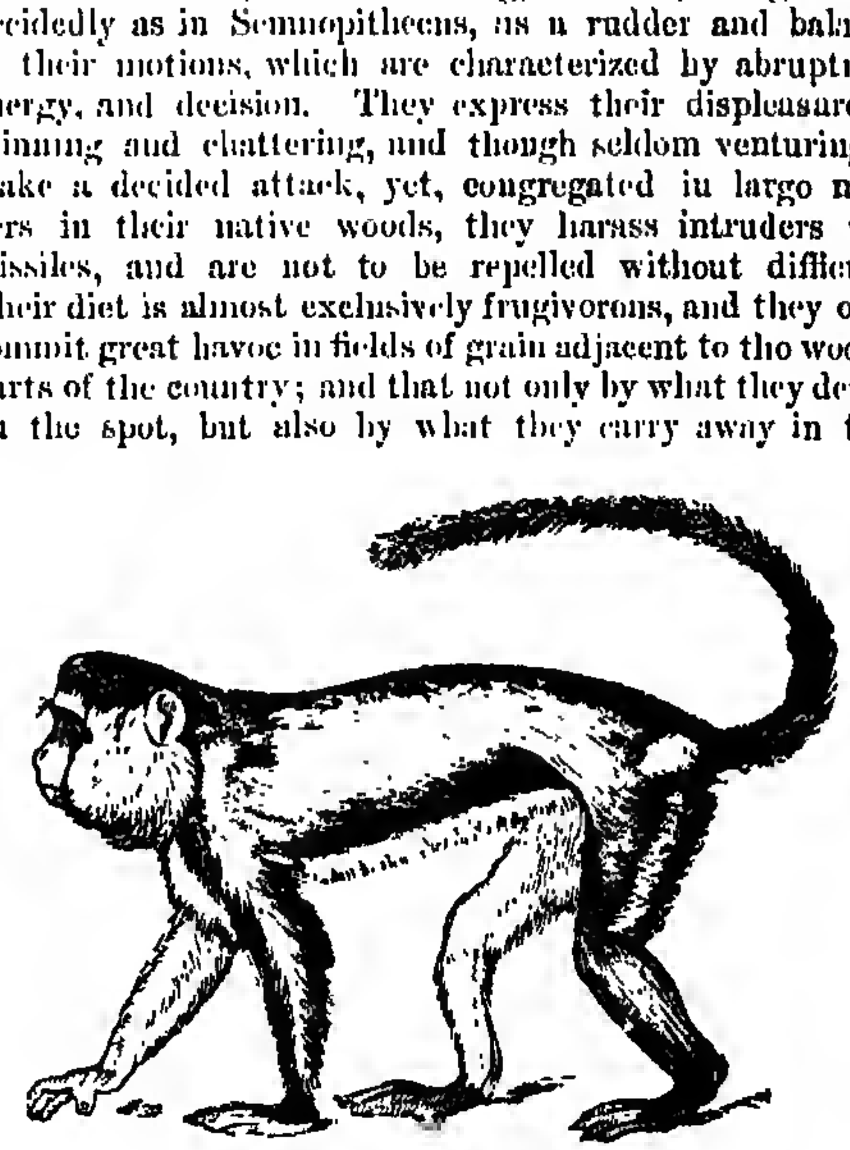
GUEL'DER (or GUELDRES) ROSE is a native of the British Isles, Europe, and temperate Asia. It is a small tree, from 6 to 12 feet high, with smooth three to five lobed leaves. The flowers are small and white, arranged in large cymes; the outer flowers in each cyme have neither stamens nor pistil, but are much enlarged. In the cultivated variety all the flowers are changed in this way, and the flattened cyme becomes a globular branch of white blossoms, whence its common name of "snowball tree." The Guelder Rose (*Viburnum Opulus*) belongs to the same genus as the Wayfaring Tree (*Viburnum Lantana*), and the same order, CAPRIFOLIACEÆ, as the elder and honeysuckle. The fruits are juicy and red, and although they possess purgative and narcotic properties, they are eaten in Norway and Sweden, after being fermented with honey and flour. Spirit is also distilled from them. The wood is made into various small useful articles in the north of Europe.

GUEL'DERLAND or GEL'DERLAND, a province of the kingdom of Holland, lying between 51° 45′ and 52° 32′ N. lat., 4° 57′ and 6° 47′ E. lon., is bounded N. by the Zuider Zee and Overyssel, W. by Utrecht and South Holland, S. by North Brabant, and E. by the Prussian Rhein-Provinz. Its area is 1932 square miles, and the population 470,000. The surface is in general level, but not so flat or low as the adjoining maritime provinces, and the climate is healthy; the soil is good and the pasture luxuriant; but there is a considerable quantity of heath and barren land, some of which is planted with firs, pines, and oak. Guelderland is watered by the Rhine, the Waal, the Yssel, the Maas, and the Leck, besides which rivers there are several canals. It is crossed by the Amsterdam and Arnheim Railway. Wheat, rye, buckwheat, potatoes, hops, and tobacco are the principal crops. Orchards are very numerous, and the province is altogether the finest in Holland. Portions of it bear the name of the "Dutch Paradise," being studded with country seats, parks, and gardens. Some few manufactures are carried on; among these paper-making and tanning are the principal. The capital of the province is ARNHEIM.

GUELFS and GHIBELLINES, the names of two great political parties which divided Italy and Germany during the middle ages. The words originally were the war-cries of the partisans of the Emperor Conrad of Franconia, of the Hohenstauffen family, whose brother and chief soldier, Frederick, was born at Waiblingen, and of Henry the Lion, duke of Bavaria, a rival candidate for the empire, of the family of Welf (1138). "Welf against Waiblingen" meant the opposition against the government; and as the popes out of jealousy assisted the malcontents against the emperors, the party cry came to mean also pope against emperor. The names passed into Italy, and in the Italianized form of Guelfs and Ghibellines during the reign of Frederick II. divided Italy into two camps. When the emperors lost their hold upon Italy, the names of Guelf and Ghibelline were used to distinguish the municipal factions, the Ghibellines being for the most part animated by a spirit of aristocracy, the Guelfs professing to be favourers of a popular form of government. By the close of the fifteenth century the names had become a mere traditional shadow, and were at length extinguished with the independence of the Italian republics.

GUE'NON, the name of a group of monkeys belonging to the African continent and its islands, and forming the genus Cercopithecus of the dog-shaped apes. The leading characters of this genus are—muzzle moderately prominent; the facial angle forty-five to fifty degrees; head round; superciliary ridge moderate; molars crowned with acute tubercles; last molar of the lower jaw, except in one subgenus, with only four tubercles; cheek pouches usually ample; laryngeal sac variable; callosities moderate; general contour light, but vigorous; limbs muscular tail long; fur moderate; hair in general annulated.

The guenons are arboreal in their habits; they frequent wild forests, and associate in large troops, being all gregarious in their habits. Their actions are full of energy; restlessness, petulance, and inquisitiveness mark their disposition. During infancy they are gentle, but become irascible and malicious with age. Though their form is light, it is muscular and vigorous, and the limbs are well proportioned; hence the guenons differ very materially from the monkeys of the genus SEMNOPITHECUS, having neither the meagre contour of body, the long slender limbs, nor the depressed face of the latter. The chest is deep, the loins narrow; the tail is long, and acts, though not so decidedly as in Semnopithecus, as a rudder and balancer in their motions, which are characterized by abruptness, energy, and decision. They express their displeasure by grinning and chattering, and though seldom venturing to make a decided attack, yet, congregated in large numbers in their native woods, they harass intruders with missiles, and are not to be repelled without difficulty. Their diet is almost exclusively frugivorous, and they often commit great havoc in fields of grain adjacent to the wooded parts of the country; and that not only by what they devour on the spot, but also by what they carry away in their



Mona (*Cercopithecus mona*).

cheek pouches, which extend beyond the angle of the lower jaw, and which, when opportunity serves, they cram with food to be eaten at leisure.

The genus Cercopithecus includes those monkeys of the Old World which are most commonly brought to Europe, and also those which have most frequently produced young ones in our menageries. The female, under these circumstances, carries the young one in her arms until it has acquired strength enough to cling firmly to her hair, when,

having all her hands at liberty, she is able to spring and climb about with as much activity as if she had no burden. The male is sometimes, if not always, an exceedingly bad father, quarrelling with the female and ill-treating the young one.

The guenons are numerous, and resolve themselves into several small groups or sets, according to the mutual alliances of the species. The Mangabey forms a good sub-genus. It is characterized by the presence of a fifth tubercle on the last molar of the lower jaw, by the magnitude of the upper middle incisors, and by the hair being destitute of annulation. This group is often made a separate genus under the title Cercocebus. As an example of the genus Cercopithecus we may select the Mona Monkey (*Cercopithecus mona*) of Western Africa. The specific characters of this elegant guenon are as follows:—Head of a yellowish-olive colour; a black frontal stripe above the eyebrows is surmounted by another of a whitish tint; back chestnut brown; haunches and limbs externally dusky black; tail black, with a white spot on each side of its origin on the hip; under parts and inside of the limbs white; whiskers very full, of a yellowish tint, slightly washed with black. Two other guenons to which special interest attaches are noticed elsewhere: the DIANA MONKEY (*Cercopithecus diana*) and the TALAPOIN (*Cercopithecus talapoin*).

GUERCI'NO (properly *Giovanni Francesco Barbieri*, Guercino being merely a nickname meaning "squinter," due to a personal peculiarity) was born in the year 1590, at Cento, a village near Bologna, belonging to the province of Ferrara. He gave very early proof of his talents by painting a figure of the Virgin on the front of his father's house when he was only ten years of age. He studied under his countrymen Cremonini and Benedetto Gennari. In his first style he followed the manner of Caravaggio. His second style, which is the best and most esteemed, was formed on the results of his observation, the study of the Roman, Venetian, and Bolognese schools, by his connection with the most eminent scholars of the Carracci, and the personal friendship of Caravaggio. He established an academy at Cento in 1616, to which numerous disciples resorted. Guercino, while not one of the greatest painters, has yet very fine qualities; his colouring is brilliant, and his chiaroscuro has a fine depth. His later works, wherein the influence of Guido is apparent, often excel in expression. The "Angels weeping over the dead Christ," in our own National Gallery, is one of the most esteemed works of the artist. He died at Bologna in 1666, in the seventy-sixth year of his age. His works are at Rome, Parma, Piacenza, Modena, and Reggio, and in most of the museums and cabinets of Europe.

GUER'ICKE, OTTO VON, a German philosopher, was born at Magdeburg, in Prussian Saxony, in 1602. He is celebrated as the inventor of the air-pump and the electrical machine. He also discovered electrical repulsion, and first observed the electric spark, and made successful researches in astronomy, discovering the periodicity of the return of comets. He was at one time an alderman of Magdeburg, and subsequently mayor of that city. His last years were spent in retirement at Hamburg, where he died in 1686.

GUERRIL'LAS (from Spanish *guerra*, war), a body of men who fight in a desultory manner, and more especially applied to those Spanish *guerrilleros* who took up arms against the French during their invasion of the Peninsula. Hence the general operations of that war were distinguished by the activity and determination of the Spanish guerrillas, who, without discipline, but acting in concert, assembled in bands at a brief notice, and employed themselves in intercepting detachments and convoys as they passed through the mountains. General Mina, who had 3000 of those men under his command, was one of the principal chiefs, and many extraordinary feats are related as having been performed by him. This term was also applied during the Civil War in the United States to armed companies of men when not embodied in the regular army.

GUERN'SEY is one of the islands of the English Channel belonging to England, is situated between 49° 24′ and 49° 30′ N. lat., and 2° 32′ and 2° 41′ W. lon. The form of the island approximates to that of a right-angled triangle: the sides face the south, east, and north-west, and are respectively about 6½, 6, and 9 miles long. The coast is somewhat difficult of approach, from the number of the rocks and the rapidity of the currents around it. The tides rise to the height of 32 feet. The northern part of the island is a level tract, and the coast for the most part lies low; the southern part is more elevated, but the high ground is intersected by narrow valleys and deep glens, and the coast is lofty and abrupt. Springs and rivulets are plentiful. The island is almost entirely of granitic formation; the rocks are chiefly gneiss, granite, and sienite. The total area of the island is 16,000 acres, and the population in 1881 was 32,659.

The soil is fertile, but under the law which gives to each son an equal share in his father's property, the improvement of the land has been checked in parts by subdivision. A man who farms 20 or 30 acres is accounted a large farmer; the holdings commonly vary from 5 to 12 acres, and subdivision is progressively going on. Cows are bred in large numbers, and are much valued for the quantity and richness of their milk. Large numbers of pigs are kept, and poultry are extensively reared—eggs forming a considerable item in the exports from the island. The chief crops are fruit, vegetables (especially potatoes), wheat and barley, and apples for cider. The climate is moist but healthy, and so mild that oranges, melons, figs, myrtles, and the Guernsey lily flourish luxuriantly. In the north are many tracts of heath; and as wood is not plentiful, fences are commonly made of stone or turf. In some parts, however, there is tolerable abundance of wood, and gentlemen's seats are generally shaded by trees. The shores are abundantly supplied with fish, and most of the small farmers divide their time between agriculture and fishing.

The manufactures are of no importance, being only such as are required for local wants. Granite, from Sampson Harbour, employs most of the shipping. The stone is much valued for its hardness and durability, and, prior to the introduction of wood and asphalt, was much used in paving the streets of London. The principal articles made in the island are soap, candles, cordage, vinegar, and cider. Ship and boat building are carried on, and there are several brick-fields and ornamental pottery works. There are also three or four breweries and manufactories of imitation West Indian cordials. Guernsey is often used as an entrepôt for strong wines by the London houses. Bread and meat are nominally about the same as in England, but the difference in weight reduces the price: the pound weight is the old Dutch pound, containing 1¾ ounces more than the English. In addition to this prices are less than they appear, since French gold and silver being the currency, twenty-four francs make a pound, whereas a sovereign is worth twenty-five; thus £100 worth in Guernsey equals £104 3*s.* 4*d.* in English currency. Land is measured by *perches* and *vergées*. A perch is 21 feet square; 40 perches = 1 vergée; 2½ vergées = 1 English acre.

The only town in Guernsey is St. Peter's Port, situated on the slope of a hill about the middle of the eastern coast. What is termed Hauteville (the upper town), on the slope of the hill, to the south-west of the old town, is the most modern and best built quarter. The appearance of St. Peter's Port, on approaching it by sea, is imposing. As the houses rise one above the other, little or nothing is

lost to the eye. The streets, however, are narrow, steep, and crooked; and in the old town the houses, though substantial, are dusky-looking and old. The government house is a substantial building. Near to it is Elizabeth College, a handsome and extensive building, of mixed architecture and monastic appearance, surrounded with spacious ornamental grounds. St. Peter's Church, a court-house, prison, hospital, three markets, a public library, theatre, assembly room, a mechanics' institution, savings bank, two joint-stock banks, are among the chief institutions and buildings of the town. St. Peter's Church is a fine building of the fourteenth century, and there are several dissenting chapels. A handsome memorial statue of the Prince Consort was erected near the harbour in 1863. It is a fac-simile of the statue at South Kensington Horticultural Gardens. In 1878 an obelisk, 78 feet in height, was erected to Admiral Lord de Saumarez, a native of Guernsey. The town has regular steam communication with Southampton, Weymouth, and London. The harbour of St. Peter's has been wonderfully improved in recent years, and two breakwaters protect it. On the extremity of the southern breakwater there are a tower and lighthouse—the light shown being visible at a distance of 9 miles. The harbour is defended by Castle Cornet and Fort George, a regular fortification on the heights, which stands about half a mile south of the town. It has barracks for 5000 men. The town is the residence of military and civil governors, both appointed by the crown. The population is 17,000.

St. Sampson's is about 2 miles from St. Peter's, and is chiefly noticeable as the place from which the granite is exported. It has increased and been improved in recent years. The harbour has also been improved, a breakwater carried out, and some new quays constructed. The quantity of granite exported is about 100,000 tons annually. Population, 8000.

Guernsey has a political constitution of its own. The island is under a lieutenant-governor, who represents the sovereign in the Assembly of the States, a parliamentary body composed of the bailiff (who is the speaker) and twelve jurats or judges of the royal court, eight rectors and two constables of each parish, and fifteen deputies from the whole island. These have the power of making laws and imposing taxes. The latter are very moderate, and produce an annual revenue of about £10,000.

The chief court of justice in the island is the royal court, which consists of the bailiff and twelve jurats, the former appointed by the crown, the latter by the islanders. There is an appeal in certain cases to the queen in council. Norman customs and ancient precedents form the basis of the civil jurisprudence, which is a complex mixture of Norman and English law. The power of the royal court is very extensive and undefined; it has jurisdiction over all the Channel Islands, except Jersey. Pure French is used in judicial and other public proceedings.

The island constitutes a deanery in the diocese of Winchester. The incumbents receive only the small tithes, and the livings are poor. The glebe-houses are kept in repair at the expense of their respective parishes. The churches are all of great antiquity. Methodists and other dissenters are numerous. Attempts have been made to induce the British government to constitute the Channel Islands into a separate diocese, but without success. The crown derives an annual revenue of about £3500, the bulk of which is spent in the island in salaries, &c.

Guernsey contains a considerable number of wealthy inhabitants, and there is a greater degree of refinement than in Jersey; but also a greater spirit of exclusiveness, which has excited the notice, and in some cases the ridicule, of visitors. The best society is in dress, manner, and language on a level with society of the same rank in England. The country people may be divided into three classes: (1) the substantial landowners and farmers, (2) the small proprietors, and (3) the cottagers. The natives of the lower order speak the old Norman-French. The knowledge of English is very general among the upper and middle classes. The principal place of education is Elizabeth College, at St. Peter's Port. In each of the parishes there is a school with a small endowment, and there are several other schools and benevolent institutions.

In the sixth century Christianity was introduced into the Norman isles by Sampson, archbishop of St. David's, and by St. Magloire or Maglorius. The religion of the island previous to this period was Druidism, and several cromlechs and other supposed relics of that system remain in the northern portion.

The Channel Islands were included in the duchy of Normandy, and are the only relics of that duchy which remain to the English crown. Guernsey was unsuccessfully attacked by the French in the reigns of Edward I. and Edward VI. In the civil war of Charles I. it sided with the king's party. Protestantism was introduced into the island in the reigns of Henry VIII. and Edward VI., and made considerable progress. The islanders have ever since been remarkable for their adherence to the faith of the Reformation, but have always shown a leaning rather to the Presbyterian than to the Episcopal discipline.

Herm is within 2½ miles of Guernsey; it measures about 1½ mile by half a mile. It is loftiest in its southern part, where the coast is bounded by cliffs; the northern part has a low shore, with sands extending some distance beyond high-water mark. It is rich in corals, sponges, and corallines. The shores afford abundance of seaweed for manure. The island is composed of gneiss and granite, which last was quarried in large quantities for the Thames Embankment. It has one little harbour. Herm attracts conchologists by a beach extending from a half to three-fourths of a mile, composed of small perfect shells and fragments of larger ones, without the least intermixture of sand or pebbles.

Some hundreds of acres of land are under indifferent cultivation. The produce of the island is mostly corn, potatoes, and a few sheep; wild rabbits are abundant.

Jethou lies south by west of Herm, distant half a mile from it, and 2½ miles from Guernsey; it is less than half a mile long and about a fourth of a mile broad. It is considerably elevated in proportion to its extent, and the sides are precipitous, except at one spot. It is chiefly composed of gneiss, which was largely used in constructing the harbour of refuge at Alderney. Very little land is under cultivation, the island being principally a rabbit warren.

GUESCLIN, BERTRAND DU, the celebrated Constable of France, was born of an ancient family near Rennes, about 1315. He was a born soldier, an adept from his youth at the exercises of the tilt-yard, but almost hopelessly dull at his books. In the fearful war with England Du Guesclin first came to the front. After King John of France had been taken prisoner to England by the Black Prince, Du Guesclin was the heart and soul of what defence there was. The grateful Charles V. when he came to the throne created him Count of Longueville. His great successes made him the only French general feared by the English, consequently when he fell into their hands at the battle of Auray in 1364 they set his ransom at the exorbitant rate of 100,000 livres. Charles begged and borrowed the money, however, and freed his benefactor.

Du Guesclin now passed into Spain to take part in the war against Pedro the Cruel, king of Castile, whom he eventually defeated and slew in battle in 1369, and during this war he was taken prisoner by the Black Prince, who treated him with great respect, and himself aided to ransom him. The new King of Castile heaped dignities upon Du Guesclin, who however returned to France as soon as Castile was settled, was created Constable of France, and

at once took the lead of the desperate rally against the English which began in 1370. His great opponent the Black Prince had died, and no one now could stand against the skill and patriotism of Du Guesclin. He cleared district after district in the most splendid manner. He died, seized by a sudden illness, while besieging a castle in Languedoc, 1380. The grief of the French king at his loss and his respect for his memory knew no bounds. He was buried among the kings of France, in the Cathedral of St. Denis, in quite royal state.

GUEUX (beggars) was the scornful epithet flung at 300 Protestant deputies who, under the leadership of Counts Brederode and Nassau, petitioned Margaret, duchess of Parma, in 1566, to abolish the Inquisition. Philip II. of Spain had made this princess, his sister, governor of the Netherlands, and her good sense and good temper had gone a great way towards keeping them in submission. In this year, however, he established the Inquisition, partly in his bigoted religious zeal, partly knowing that it would cause disturbances, under cover of which he could withdraw the hated liberty of the Flemish towns. Margaret was powerless to grant the petition, and indeed was very soon superseded in the government by the ferocious Alva. Meanwhile the Protestants adopted the nickname given them, and a powerful confraternity of *Gueux* was quickly formed, the staff, wooden bowl, and wallet, and even the ragged gown of the professional mendicant, being donned by themselves and their servants. Their badge was two hands clasped through the mouth of a double wallet, with the purposely unfinished motto *Porter la besace jusques à* . . . ("Carry the wallet until . . ."). The Gueux thus forming a rallying-point, it was not long before the revolt broke out which ended in the downfall of the Spanish rule in the Netherlands.

GUIA'NA, GUYA'NA, or **GUAYA'NA,** the north-eastern portion of South America, extending from the banks of the river Orinoco southward to those of the river Amazon. It is bounded on the west by the Guainia or Rio Negro, the natural canal of Cassiquiare, and the middle course of the Orinoco. Its surface covers an area of more than 650,000 square miles, but more than five-sixths of it are included within the boundaries of the Empire of Brazil and the Republic of Venezuela, under which articles these portions are noticed. We limit the present general description to those parts which comprehend the British, Dutch, and French settlements, and which cover a surface of about 130,000 square miles. The boundaries between these settlements and the other two portions are only vaguely determined; but for the most part the districts drained by the rivers which fall immediately into the Atlantic Ocean belong to the European nations, while those which are drained by the streams which fall into the Amazon and Orinoco are appurtenances of Brazil and Venezuela respectively. French Guiana is more particularly noticed under CAYENNE, and Dutch Guiana under SURINAM.

Surface, Rivers, &c.—The shores of this country are skirted by a mud bank, extending about 7 or 8 miles out to sea, rendering the approach from the sea exceedingly monotonous and difficult. Low land extends from the coast for from 40 to 70 miles inland, and is mostly on a level with the sea at high water. This land can with difficulty be protected from the sea, but when drained and cultivated it yields rich crops. In fact, such are the depth and fertility of the soil that the same land has been productive annually through more than half a century without manure, without rotation of crop, and without a pause.

The civilized and cultivated portion of the colony, however, lies along only a comparatively narrow strip of sea-coast. Behind this are swamps, then wooded rising-ground, and finally, mountains and savannahs stretching southwards, all lying in a state of nature—the haunts of wild animals and various Indian tribes. This portion is known as the "Interior," and with the exception of a few settlements on the banks of the lower Berbice, Demerara, and Essequibo rivers, it remains in much the same state in which it was in the time of Sir Walter Raleigh.

The largest river is the Essequibo, which traverses nearly the middle of British Guiana. At a point 230 miles from its mouth the river is still some hundred yards wide, and forms a great cataract, called King William's Cataract. It is, however, only navigable for large vessels up to its first falls—a distance of 60 miles from the sea. In the wide estuary of the Essequibo there are numerous islands, some of which are extensive. Among them are Hog Island, Wakenaam, Leguan, and Tiger Island.

East of the Essequibo and parallel to it runs the Demerara, whose sources lie a little south of 5° N. lat. At 5° 25′ N. lat. it forms a great cataract, and below it becomes navigable for small craft. This river runs more than 200 miles, and as it affords an easy means of transport for goods there are many settlements on its banks.

Further east runs the Berbice, whose source is situated about 3° 40′ N. lat. It has many rapids and cataracts, but is navigable for 165 miles.

The Corantin River forms the boundary between the Dutch and British possessions. At 200 miles from its mouth it is still 900 yards wide. Like most of the other rivers of Guiana it has many rapids and cataracts, and its course is very tortuous. Near its mouth is an island, Parrot Island, 7 miles long. Seventy miles from the sea the tide rises 30 inches.

The river Surinam, which traverses the middle of the Dutch territories, rises somewhere about 4° N. lat. It enters the low plain at about 4° 40′ N. lat., and so far it is navigable for river barges. Towards its mouth it increases to a mile in width, and north of Paramaribo it is still wider. Vessels of considerable size can enter it and sail up to that town.

The Marony, which divides the Dutch and French colonies, has many rapids and cataracts south of Armina, in 4° 45′ N. lat., to which the tide ascends. From this place to its mouth it is not less than 1½ mile wide, but full of islands. Large river vessels can ascend to Armina.

The smaller streams are the Pomeroon, the Moruca, the Wai-ini, between the Orinoco and the Essequibo; the Mahaica, the Mahaicony, and the Albany, between the Demerara and the Berbice; and the Canje, which joins the latter immediately before it falls into the sea. All these streams are continually bringing down quantities of detritus, and the coast-line is consequently undergoing considerable changes. In one place the drainage of the estates is blocked up by drift-mud, and in another incessant exertion is required to repel the encroachments of the sea.

Climate and Productions.—Guiana has two rainy and two dry seasons. The long rainy season sets in about the middle of April, and lasts till August. The long dry season continues from August to November. February and March constitute the short dry season, but they are not quite so free from showers as the long dry season. The heat is not so great as might be supposed, considering the position of the country near the equator and the lowness of the coast: the trade winds and the land and sea breezes tend to cool the air. The thermometer, even in summer, seldom rises above 90°, and it does not often descend below 75°. Though Europeans are subject to some diseases on their arrival, it is now well known that the climate of Guiana is more healthy than that of most places in the West Indies. Thunderstorms hurricanes, and earthquakes are rare.

Few countries on the surface of the globe can be compared with Guiana for luxuriance of vegetation, which shows itself especially in the great number of indigenous plants and the large forest trees which cover perhaps not less than one-half of its surface. Timber, furniture-wood,

and dyewood are afforded in abundance. Indian corn, rice, wheat, cacao, vanilla, tobacco, cinnamon, mandioca, yams, sweet potatoes, arrow-root, bananas, pine-apples, cocoa-nuts, sugar, coffee, ginger, pepper, cloves, nutmegs, and cotton—all are grown in Guiana. The principal attention of the landed proprietors is now concentrated in the growth of sugar and the manufacture of rum; but the timber trade has of late years assumed a very great degree of importance.

The domestic animals are the same as in England. Black cattle grow to a greater size than in Europe, but their flesh is not so tender nor of so fine a flavour. The wool of the sheep is converted into hair. Among the ferocious animals are the jaguar and cougnar. Other animals are the armadillo, agouti, ant-bear, sloth, monkeys, lizards, iguana, alligators, bats, and snakes. The birds and insects are very numerous.

Inhabitants.—Guiana is inhabited by Europeans, Africans, and native Americans. The Europeans are mostly descendants of Dutch settlers, but some are descendants of Englishmen and Frenchmen. The Africans were brought over to cultivate the country as slaves, and are much more numerous than the whites. In British Guiana there are six tribes of natives, who are much more civilized than the aboriginal tribes who inhabit the adjacent countries. Some of them work for the English settlers.

History.—Guiana was discovered before the end of the fifteenth century by Vincent Pinzon. The Dutch formed the first settlement about 1580 on the Demerara River, and afterwards at other places. The English settled in 1634 in the neighbourhood of the Berbice and Surinam; but in 1667 the English settlements were given up to the Dutch. The French occupied Cayenne in 1633. During the last war with France the English occupied the Dutch settlements; and by the treaty of Paris, 1814, they restored only those between the Corentyn and the Marony to the Dutch, retaining possession of the remainder.

GUIA'NA, BRITISH, extends from east to west about 200 miles. It includes the settlements of Demerara, Essequibo, and Berbice. It is bounded on the east by Dutch Guiana, from which it is divided by the river Corentyn, on the south by Brazil, on the west by Venezuela, and on the north and north-east by the Atlantic Ocean. This territory was first partially settled by the Dutch West India Company in 1580. It was from time to time held by Holland, France, and England. It was restored to the Dutch in 1802, but in the following year retaken by Great Britain, to whom it was finally ceded in 1814. It is impossible to specify the exact area of the colony, as its precise boundaries are undetermined between Venezuela and Brazil respectively, but it has been computed to be 76,000 square miles. The population in 1881 was 252,186, an increase of 58,695 in ten years.

Public affairs in British Guiana are administered by a governor invested with large powers, responsible to the queen in council, and aided by a peculiarly-constituted colonial assembly, based to a great extent on the system under which affairs were formerly administered by the Dutch. The three counties of Berbice, Demerara, and Essequibo form a diocese of the Anglican Church. The colony is altogether divided into seventeen parishes, of which seven belong exclusively to the Church of Scotland and eight to that of England; while the two in which the towns are situated have a minister of each church appointed to them. The ministers of both churches, as well as those of the Roman Catholic and Wesleyan, are supported by the state, but independent missionaries throughout the colonies are maintained by their own congregations.

The staple products of British Guiana were in former years sugar, rum, molasses, cotton, and coffee, but the cultivation of the two last-named articles has for many years past been almost entirely abandoned. The soil of some parts of the colony is, however, still capable of producing coffee of rare excellence. The Berbice River coffee was once much prized; but these two industries have now given place to the cultivation of the sugar-cane, which at present is the chief industry of the colony, and furnishes nearly 92 per cent. in value of its exports.

The question of labour—the greatest of questions in the West India colonies—has been settled more or less satisfactorily in British Guiana by the instrumentality of a vigorous immigration system. This has not only supplied numbers, but variety; and the consequence is that, with one nationality to set off against another, not only is there a potential incentive to all to work, but there comes to exist a considerable natural guarantee against riot and labour troubles of all sorts. Since slavery was abolished immigration has brought into the colony the following numbers and kinds of labouring people:—East Indians, 100,000; West Indians, 33,000; Portuguese, 30,000; Africans, 14,000; Chinese, 13,000. With all these advantages—of tillage, of labour, and of invested capital—the planters have thus been enabled to produce sugar on a system secure against any competition elsewhere.

The forests of British Guiana abound in woods of rare beauty and value. Some of the hard woods are, from their remarkable durability, peculiarly suitable for house and shipbuilding purposes, while others are equally prized for the manufacture of articles of household furniture. The climate is hot but not unhealthy. The mean temperature throughout the year is about 82° Fahr. The heat is greatly tempered by the cooling breezes from the sea, which prevail during the greater portion of the year. The heat is felt more in August and September than at other times, owing to the partial cessation of these breezes. Georgetown is the capital of British Guiana. It is situated in lat. 6° 49′ 21″ N., and lon. 58° 11′ 30″ W., and possesses a population of upwards of 40,000. The revenue and expenditure of the colony are each about £450,000 per annum. The average value of the imports is £2,000,000, and of the exports £2,500,000 per annum.

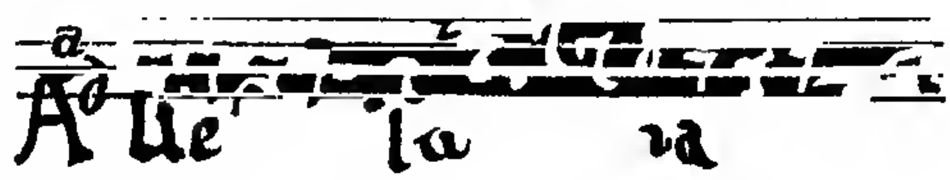
GUICCIARDI'NI, FRANCESCO, a celebrated Italian statesman and historian, was born at Florence, 6th March, 1482. He came of a noble and distinguished family, and at an early age evinced an extraordinary aptitude for classical learning. Having adopted the profession of an advocate, he was at the age of twenty-three appointed to a professorship of Roman law at Florence. In 1512 he was sent as an ambassador to Ferdinand of Spain, whose interest he secured on behalf of the Florentines, and in 1515 he was chosen to confer with Pope Leo X. at his entrance into Florence. His ability was at once recognized by that pontiff, who secured his services and appointed him to the governorship of Modena, Reggio, and Parma. He was confirmed in his honours by Adrian VI., and Clement VII. in 1523 appointed him viceroy of Romagna, and in 1526 lieutenant-general of the papal troops. In 1531 he was advanced to the governorship of Bologna. On the accession of Paul III. Guicciardini retired to Florence, where he placed his services at the disposal of Alexander de' Medici, and assisted this dissolute tyrant in his opposition to the republican tendencies of that state. On the assassination of Alexander in 1537 he espoused the cause of Cosmo I., who mainly through his influence became ruler of Florence, but who immediately afterwards discarded him. Guicciardini retired from court to his villa at Arcetri, where he devoted himself to the writing of history, a task for which his previous experience had endowed him with peculiar qualifications. He died 22nd May, 1540, aged fifty-eight. He has been accused of want of patriotism, ambition, avarice, cruelty, and an utter indifference to any principle beyond that of self-interest, and these charges, though made in the first instance by his enemies, have in modern times received full confirmation from the publication of his

own writings. His greatest work, and that upon which his fame mainly rests, is a "History of Italy from 1494 to 1532," which has been not unjustly described as the greatest historical work that had appeared since the beginning of the modern era. Its style is proverbially heavy, cumbrous, and prolix to an extreme degree, but the work gives a true and complete exposition of the tangled political events of the period which it covers. In 1561 the first sixteen books of the history were published, and three years later four additional books were published. A fine edition, in four vols. 4to, was published at Fribourg, 1775–76, and another, edited by Rosini, in ten vols. 8vo at Pisa in 1819. In 1857–58 there appeared at Florence a further edition of the works of Guicciardini in ten volumes, published from the manuscripts preserved by the family, and edited by Guiseppe Canestrini. The chief items of this last edition are a history of Florence from 1378 to 1509, a treatise on the government of Florence, and a series of short essays and aphorisms bearing on political subjects.

GUI'DO, the famous painter, whose name was Guido Reni, was born at Bologna in 1575, and died in 1642. After Domenichino, he must be reckoned the most famous pupil of the celebrated Carracci, to whom Italy was indebted for a splendid afterglow following the glories of the Renaissance. Guido had an exquisite feeling for beauty of form, and sometimes his colouring is charmingly subtle, but his expression is often over forced. His well-known "Ecce Homo" (Jesus wearing the Crown of Thorns), in the National Gallery, is a noble example of the master, but the effect is palpably strained, and the great value of the picture so far lessened. His finest work is the perfect fresco at the Rospigliosi Palace at Rome, where it decorates the ceiling. It is the dawn allegorically shown, Apollo surrounded by the hours, led on in his sun-chariot towards the awakening world by Aurora, goddess of dawn. It is difficult to imagine more tender grace of form and colour than pervade this unique work. Guido was a great spendthrift and gambler, and much of his works bear the marks of hurry and carelessness. A fatal facility enabled him to earn easily what he spent as recklessly. But the "Magdalen" in the Colonna Palace, and the "Beatrice Cenci" in the Barberini Palace at Rome are among the best-known and best-loved pictures in the world.

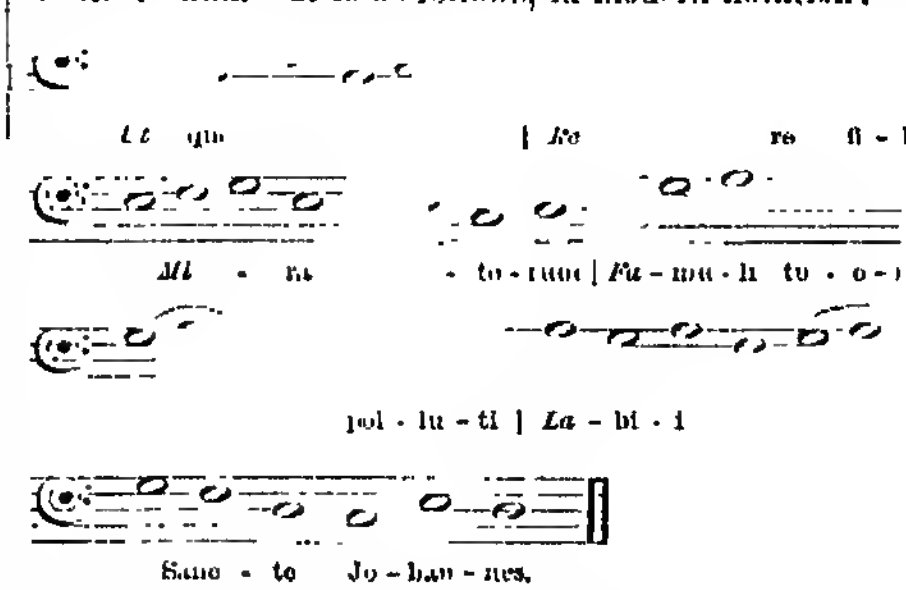
GUI'DO D'AREZ'ZO (*Guido Aretino*) was born at Arezzo, in Tuscany, towards the end of the tenth century. When young he entered a Benedictine monastery, and afterwards became a monk of the order. There he is said to have first conceived a new method of writing music, and of instructing in the art; and having well digested his plan, he there also carried it into effect at a school opened by him for the purpose. He wrote a "Micrologus," or brief discourse on music, in which most of his inventions are described, as well as his method of instruction. To Guido we are said to be indebted for the invention of the stave—*i.e.* the lines and spaces in music—for the reformation of the scale, as also of the mode of notation, and for the art of solmisation.

This is, however, one of the many cases in history of the tendency of a great name to form a resting-place for traditions which, in fact, should have little or nothing to do with it. As far as can now be known Guido, so far from being in advance of his age, was rather conservative in a theoretical sense. One thing is certainly his own, and it is of great practical merit. Guido hit upon the happy idea of teaching one single tune or some few tunes so firmly as a beginning, that in this way scholars might have a fixed point to reckon from in deciphering notes from the stave. He had found in use a stave of two lines (a scarlet line, *f*, and a yellow line, *c'*); he still kept these, generally using green instead of yellow for *c'*, however, and added to them two other lines, one between the two first (*a*), and one below them (*d*). He used the signs called *neumes* upon these lines and in the spaces, as is shown in the following copy of part of an authentic fragment:—



Guido's notation by *neumes* on a four-line stave; the thicker lines are coloured in the original, the top one green (the *c'* line), the lower one scarlet (the *f* line). Guido's two new lines are marked *d a* by him respectively.

This system, so easy to us, was incredibly difficult then, and Guido's idea of teaching a central tune was hailed with enthusiasm. He gives one specimen of a tune, evidently his favourite for the purpose, and certainly wonderfully chosen. It is of such importance that it may be printed in full; the words being an ancient hymn to St. John, pleading for freedom from hoarseness for the singers, both words and music being far older than Guido. In fact, the favourite nature of the well-known tune made it the more useful to him. It is as follows, in modern notation:—



A little familiarity will soon conquer the strange feeling of timelessness which hangs about this tune, like all the rest of old Gregorian music so called, and the reader then perceives that the tune rises by one note of the scale to each line of the words. *Ut, re, mi, fa, sol, la* are the syllables of the successive lines, and if *ut* be C, then the whole series would be C D E F G A. So wonderful was the assistance thus gained, the first mediæval conception of a scale, that these syllables have remained in force till these days; and they still serve for us, with the addition of *si* for the seventh of the scale (B in the scale chosen), and with the substitution in Italy and England of *Do* for the less melodious *Ut* still used by France. Also the Guidonian scale, being thus accidentally of six notes, that number became crystallized, though neither the system of *hexachord* scales nor *solmisation* (or sol-faing), which thus grew up from Guido's system, were ever planned by him, as used to be alleged.

Finally, after Guido's time, when his genius for practical teaching no longer aided men, these things became almost insuperably difficult, and the "Hand of Guido" was discovered to be of great assistance in threading the intricacies of the hexachords. But as Guido never knew of the latter, it is clear the invention of the former cannot be due to him. The "Hand of Guido" is often thought to be a mode of using the teacher's left hand as representing the five lines of the stave, which can readily be taught in this way, using the right hand as a pointer; but firstly, Guido's stave was of four lines only, and secondly, we know exactly how the hand was really used. Guido's whole conception of music ranged only from G to *d'* or *e'*, the nineteenth or twentieth notes of male voices. The finger tips and joints give just nineteen, and a twentieth if required must be crowded in somewhere (usually doubling the tip of the middle finger), so that each point can stand for a note. An ingenious mode of passing from one point on the hand to the other,

in a winding curve, sorted them out into divisions of six, answering to the scales or HEXACHORDS of six notes.

Besides the notation by *neumes*, Guido still used the notation by letters of the older Romans, but indicating the upward or downward flow of the melody by connecting lines in a rather ingenious way, as under:—

Fragment of Guido's letter-notation, with translation.

Guido was prior of the monastery of Pomposa, near Ravenna, when he became famous as a music teacher. His skill in teaching reading and part singing in successions of fourths and fifths, and a freer system of harmony which he called *diaphony*, was so great that Pope John XIX. (1024–33) invited him to Rome. To his great astonishment the pope was able to understand music-writing in one lesson. He kept Guido in Rome until his failing health caused it to be necessary to send him back to Pomposa, where he lived till his death in 1050. He is believed to have been born in 983, and in 1883 the nine-hundredth anniversary of his birth was grandly celebrated at Arezzo by the unveiling of a statue, and an important musical festival. A statue of this great Florentine has long decorated the famous avenue of great men in the portico of the Uffizi at Florence.

GUILD'FORD, a municipal and, till 1885, a parliamentary borough, the capital of Surrey, 31 miles from London by the South-western Railway, and 22 miles from Reigate by the South-eastern line. It lies on either side of the Wey, which here breaks through the great range of the chalk downs. It is a pleasant, cleanly, old fashioned town, consisting principally of one street, which descends the steep slope of the eastern bank of the river, and abounds in quaint gabled houses. There is room for great improvement as regards sanitary matters, and the supply of water is insufficient, although amendments have recently been made in both respects, and the appearance of the town generally has been much improved. Guildford is first mentioned by name in the will of King Alfred. Here Alfred the Saxon Atheling and his Norman followers were massacred on his return from Normandy in the interest of his brother, Edward the Confessor. The castle, situated on a considerable ascent, was a Norman stronghold. In 1226 it was captured by Louis of France. Its square keep, built about 1150, is in admirable preservation. The walls are 10 feet thick and 70 high. Very large caverns in the chalk are known to exist some distance from the castle, and are believed to extend underneath the keep. They probably communicate with a crypt in the chalk beneath the Angel Hotel, now used as a wine-cellar. In the High Street stands Archbishop Abbot's Hospital, founded in 1619, a building of red brick with stone dressings round a quadrangular court. The archbishop was a native of Guildford. Opposite the hospital is the Church of the Holy Trinity, with an embattled tower 90 feet high. St. Mary's Church, in Quarry Street, is full of interest. It is partly built of chalk, but with an intermixture of flint and rubble, and consists of a nave, chancel, two side aisles, terminating in chapels and circular apses, with a central low embattled tower. The oldest portions of the church are Norman, but most of the building is Early English. On the west bank of the Wey stands St. Nicholas Church. It was built in 1836, but demolished, and a new one erected on the site in 1876. The summit of St. Catherine's Hill, famous for its beautiful and extensive prospects, is crowned by the ruins of an Early Decorated chapel, consecrated in 1317. There are chapels belonging to Baptists, Presbyterians, Quakers, and Catholics. The grammar-school, in the High Street, was founded in 1550. The buildings are ancient, and quadrangular in plan. Here were educated Parkhurst, bishop of Norwich; William and Henry Cotton, bishops of Salisbury and Exeter; Archbishop Abbot; and Abbot, bishop of Salisbury. The guildhall was erected in 1683; the new county hall, where the assizes are held, in 1862. There are paper, powder, and corn mills; breweries, brickfields, coach-works, and iron-foundries. The manufacture of cloth was formerly carried on very extensively here. From the time of Edward I. to the passing of the Reform Bill of 1867 the borough returned two members to the House of Commons, but the Reform and Redistribution Acts of 1884–85 deprived it of its only remaining member. The population of the parliamentary borough in 1881 was 11,953. The municipal borough is governed by a mayor, four aldermen, and twelve councillors. Petty sessions are held here, and the summer assizes here and at Croydon alternately.

GUILDHALL', the building in London answering the purpose of a town-hall. In it nearly all public business connected with the different offices of the corporation is transacted. The building was commenced in 1411, and additions were made at different times till the great fire of London in 1666, when the roof was entirely destroyed. The interior was renovated by Sir Christopher Wren, and again in the last century by Dance, who added the present front. During the last few years great improvements have been made, especially with respect to light and ventilation. In 1865–66 the old roof was replaced by a very handsome one in oak, of a fine Gothic design, and the interior of the building thoroughly cleansed and re-embellished—the entire cost amounting to upwards of £30,000.

The building is situated at the end of King Street, Cheapside. The large hall is 153 feet in length, 49 in breadth, and 60 in height, and is capable of containing from 5000 to 6000 persons. In it are placed the giant statues of Gog and Magog, and it is celebrated for the magnificence of the civic entertainments held there.

There are also numerous other important halls or chambers attached to the central building, such as the common council chamber, the court of aldermen, the chamberlain's parlour; and several police and other courts are held there. There are also an interesting museum, a reading-room, and a magnificent free library attached to the Guildhall, the buildings for which were erected in 1871–72, and presented by the corporation to the city.

The Guildhall is the place where the citizens have for many centuries been accustomed to assemble, not only to transact municipal business, but also freely to discuss public grievances, to consider and suggest remedies for great social evils, and to promote the general interests of humanity. Within its walls events of deep public interest and importance have taken place.

GUILDS or **GILDS** (Anglo-Saxon, *gild* or *geld*, a set payment), societies or associations formed for mutual aid and protection, or for social or religious purposes, in many of the towns of Europe during the middle ages. Similar associations are known to have existed among the Romans from a very early period in their history, and also among the Greeks in the second and third centuries B.C.; but though many attempts have been made to trace a continuity, the best authorities regard the European guilds as being of independent origin.

In England guilds (*frithgilds*) were in existence at the end of the ninth century, and the rules of many of these Saxon associations are still in existence. They seem to have been formed partly for religious purposes and partly

for mutual support and protection. The members were admitted by oath, and were required to pay a fixed contribution to the general fund. They were accustomed to meet at regular intervals for a common feast, and were entitled to relief in sickness, to protection against robbery and violence, and on the death of a brother the guild defrayed the cost of his burial and paid for masses for the repose of his soul. These associations were termed *frith* or *peace gilds*, and the statutes have been preserved of a powerful society of this kind which existed in London at the time of Athelstan.

Another form of guild, which dates at least from the time of the Conquest, and probably existed long before that event, was the *ceapmanne gilde* or *guild-merchant*, an association formed for the protection and regulation of trade. As many of the citizens of a town were necessarily engaged in trade, the need of mutual support naturally led such persons to unite for their common interest; and inasmuch as they also filled most of the municipal offices, they sought to pass such laws as would sustain their interests against outsiders and foreigners. Before anyone could become a burgess of a town, or a trader in it, it was necessary that he should become a member of the guild, and should promise to obey its regulations; and as the towns obtained their charters and privileges, the guilds also gained strength and influence. Some of these guilds-merchant received royal sanction to their claims, and vindicated successfully their commercial privileges against the oppressions of the nobility; but as their wealth and power increased they became narrow and tyrannical, and tended to exclude the handicraftsmen. This led to the formation of a new class of associations, the *craft-guilds*, for the protection of the workmen themselves in each particular craft. These societies provided each for the maintenance of the customs of its own craft, laid down stringent regulations as to the quality of the work done and the rate of wages, strove to protect the workmen from undue competition, and punished disobedient members by fine or expulsion from the brotherhood. In some great cities the craft-guilds were first in the field, and no necessity was then felt for a united body such as that of the guilds-merchant, and this seems to have been the case with the city of London. [See LIVERY COMPANIES OF LONDON.] In other places the two forms of association existed side by side, but ultimately the growing importance and power of the craft-guild caused the decay of the other.

In addition to these associations there were also formed during the middle ages a large number of guilds for social and religious purposes. Their objects included mutual devotion, the exercise of charity towards all the poorer members, and even to persons outside the guild, and the regular observance of certain religious services. Such societies drew their members from all classes, and sometimes included kings and princes among their brotherhood. They seem to have been of a very useful and beneficent character upon the whole, but at the time of the Reformation most of them were suppressed, and in England, where they had acquired considerable wealth, their property was seized by the crown and the nobility.

The English guilds, according to Professor Stubbs, assisted to promote and sustain the political influence of the towns, and helped to restrain the power of the king and his courtiers; but, on the other hand, they engrossed, for the aggrandizement of their members, many of the common rights of the people. One of the most important of the trade-guild customs or by-laws which prevailed in many of the English boroughs, to the effect that no person should keep a shop for merchandise, or should exercise a particular trade, unless he was free of the borough or of one of the guilds, was only legally abolished by the Municipal Corporation Reform Act (5 & 6 Will. IV. c. 76, s. 14), passed in 1835.

See also Brentano "On the History and Development of Gilds," included in "English Gilds," by Toulmin Smith (1870); Coote's interesting pamphlet containing some "ordinances of secular guilds" (London, 1871); and the "Constitutional History of England," by Professor Stubbs (1875–76).

GUIL'LEMOT (*Uria*) is a genus of sea-birds which belongs to the AUK family (Alcidæ).

The generic characters are as follows:—Bill of moderate length, straight, strong, and compressed; upper mandible slightly arched towards the tip; angle of the lower mandible gradually ascending; commissure nearly straight; nostrils basal, lateral, concave, longitudinally cleft, and half covered by a feathered membrane advancing from the forehead and sides of the face; wings short, narrow, and acute; tail of twelve or fourteen feathers, very short; legs situated at the back part of the abdomen; the tibiæ concealed within the integuments; tarsi short, compressed; feet of three toes, all directed forwards and entirely webbed; outer and middle toes of equal length, the inner one shorter.

The guillemots seem specially framed for existence in the Arctic and even Polar regions, and are comparatively seldom found in the warmer latitudes. In the north they swarm on all the rocks and islets of the chilling seas. In the short but bright summer that gilds some of their northern haunts they make haste to deposit their eggs, sometimes only one, on the bare rock, without wasting the precious days in making a nest. On the naked ledge that overhangs the sea the young guillemot is hatched, and, as soon as it is able to bear the shock, is conducted or rather tumbles from its hard nursery into the bosom of the ocean, where a plentiful harvest is spread for it. Here the guillemots are indeed in their element. Plying their way with wings and feet beneath the waves, and even beneath the ice, they make prey of the small fish and crustaceans which form their principal food. Their native rocks or the ice-caverns shelter them from the storm, and it is only when the winter is more than usually severe that some of these species are driven for a temporary resort to

Foolish Guillemot (*Uria troile*).

more temperate climates. Their flight is sharp and rapid, though of no long duration, and generally directed just above the surface of the sea. Their eggs, which are reckoned palatable, notwithstanding their fishy diet, have a thick shell, which has a dull appearance. All are subject to a double moult, and the summer dress differs in many respects from that of the winter.

Two species only are truly British, the Foolish Guillemot (*Uria troile*) and the Black Guillemot (*Uria grylle*). By way of example we may describe the foolish guillemot as a type of the genus.

The winter plumage of both sexes when adult is as follows:—The summit of the head, space between the eye and the bill, longitudinal band behind the eyes, and all the upper parts are of a velvety black, slightly inclining to ash; all the lower parts and the extremity of the secondaries are pure white; white is also found between the band behind the eyes and the back of the nape, and advances towards the occiput, where it forms on each side an open angle. The ashy blackish colour of the lateral part of the neck seems to form towards the breast a kind of collar, feebly indicated by bright ash. The bill is ashy black; the inside of the mouth is livid yellow, the iris brown, the feet and toes yellowish-brown; the posterior part of the tarsus and membranes are black.

The summer plumage differs in having the head, region of the eyes, throat, and all the upper part of the neck of a velvety brown, and the inside of the mouth bright yellow. The male is about 18 inches in length, the female a little smaller.

The young of the year are principally distinguished from the old birds in their winter plumage by the comparative shortness of the bill, which is ashy and yellowish at the base; the black of the upper parts is clouded with ash-colour, the stripe or longitudinal band is not distinct, and mingles by means of ashy spots with the white of the sides of the occiput. Ashy brown predominates on the lower parts of the neck, and the white of the lower parts is not so pure; the tarsi and toes are of a livid yellowish hue.

These birds are common in the Arctic seas of both hemispheres. In the British Islands they are numerous (among other localities) in the Orkneys, on the Bass Rock, the Farn or Fern Isles, the cliffs of Scarborough, the Needles and the cliffs of the Isle of Wight, the Goodeve Rocks, not far from St. Ives in Cornwall, and the Isle of Priestholme, contiguous to the island of Anglesey, &c.

The appellation of *foolish* guillemot has been given to this species from its often suffering itself to be taken by the hand or killed on the spot, especially in the breeding season, rather than quit the cliff it has chosen for its abode. The sea is the favourite resort of these birds when they leave their cliffs, and there they seek their food, consisting principally of small fish, small marine crustaceans, and small bivalves; they dive with the greatest facility. They are with difficulty roused to flight. Early in April and May, or at the end of March, they begin to assemble on their favourite cliffs in Britain, and lay their single unprotected egg on the flat bare ledge of rock. This egg is generally of a pale green, blotched and stained with black and dark brown. Sometimes the egg is white, with or without a few spots. The variety in the colour of the eggs is very great. The female sits upon the egg in an upright position. If the egg is taken away a second one is laid, but this bird seems never to lay more than two. It is a remarkable sight to see these birds, where they abound, sitting upon their eggs on their rocky shelves, often in line, and so close that they nearly touch each other. As soon as the young are capable of migrating, which is in August, or by the end of that month, they are said to disappear from our shores.

GUIL'LOCHE, one of the Greek ornaments for architectural mouldings, consisting of bands representing ribbons which interweave in simple curves closely following each other.

GUIL'LOTINE, an instrument for the infliction of capital punishment, proposed to the National Assembly of France by Joseph Ignace Guillotin, a physician, a native of Saintes, and a member of the Assembly. It was adopted by a decree of 20th March, 1792. It consists of a sharp, heavy knife with an oblique edge, moving between upright supports or guides. The knife is suspended by a catch. The victim is bound to a plank, which is then tilted up and pushed forward till his neck rests on a block directly under the knife, the executioner releases the catch, and the knife falls by its own weight. Death is apparently instantaneous. When the executioner struck Charlotte Corday's severed head brutally upon the cheek the face was seen to flush, however; and several other curious circumstances of the kind are known, calling apparently for some general explanation not yet discovered.

This instrument, or one very similar to it, under other names, had existed as a means of public execution long before in Germany, Bohemia, Italy, Scotland, and England. In German this instrument was called *der Planke der Diele* (the plank of wood), and in older language *Falbeil* (the falling hatchet). In Italy it was known by the name of *Mannaia*. The unhappy Conradin was executed by it by the brutal Charles of Anjou [see ANJOU, COUNTS AND DUKES OF] in 1268. Evelyn ("Memoirs," vol. i. p. 170) states that he saw a similar instrument at Naples. Penaecuik ("Description of Tweeddale," pp. 16, 17) speaks of the Regent Morton of Scotland being executed by the *Maiden* at the cross of Edinburgh, as "art and part" in the murder of Darnley, "which fatal instrument, at least the pattern thereof, the cruel regent had brought from abroad to behead the Laird of Penaecuik of that ilk." In England, what has been since called the guillotine was used only at Halifax, in Yorkshire, as far back as the time of Edward III. It was in 1650 that the last malefactors there suffered by it. Dr. Joseph Ignace Guillotin, who from motives of humanity revived the use of this instrument in France, is supposed by many to have perished by his own invention. But this is not correct, for he died a natural death, 26th May, 1814, at the age of seventy-six. The guillotine is still used in France for the execution of such criminals as are condemned to death without extenuating circumstances.

GUILTY is the form of verdict adopted in Great Britain when the jury decides that the crime charged against the prisoner has been proved. If they consider the crime is not proved the verdict is *Not Guilty*, and in England these are the only two verdicts that can be given. The effect of the verdict of Guilty is to condemn the prisoner, and if after sentence has been passed, the verdict is proved to have been given in error, it is not broken, but a free pardon is given to the person condemned. The result of the verdict of Not Guilty is the acquittal of the prisoner, and it is a maxim of English law that after a lawful verdict there can be no new trial in a criminal case, and that the prisoner cannot be put again in peril for the same offence. In Scotland the jury may return a third verdict, *Not Proven*, where they consider there is a strong ground of suspicion, though not enough evidence legally to convict the prisoner. Its effect is to leave a stigma on the character of the person charged.

GUINEA, an extensive country on the west coast of Africa, between 15° 41′ S. and 10° 20′ N. lat., and 10° E. and 14° W. lon. The coasts are in general low and unhealthy, but very fertile. The principal rivers are, the Niger or Quorra, the Volta, the Coanza, the Congo or Zaire, and the Assinie. The south and west coasts are watered by numerous small streams. The country is divided into North and South Guinea. The chief products are indigo, gold-dust, pepper, cotton, and the sugar-cane. In the forests the elephant, the lion, the rhinoceros, and numerous serpents are found. Fetichism is the prevailing superstition. On the south-west coast is the republic of Liberia. The mountains in South Guinea contain small quantities of copper and iron. The country was discovered by the Portuguese in 1487, and they have always retained nominal possession of the southern districts. The countries along the sea-coast are known to European sailors under six names—Sierra Leone, Grain Coast, Ivory Coast, Gold Coast, Slave Coast, and Benin. Referring for other details to ASHANTEE, GOLD COAST, DAHOMEY, LIBERIA, and

Sierra Leone, we here treat of Grain Coast, Ivory Coast, Slave Coast, and Benin.

The *Grain Coast* extends from the Sierra Leone peninsula (7° N. lat.) to Cape Palmas (4° 30′ N. lat.), a distance of somewhat less than 300 miles. The coast is rocky, and the interior is a succession of mountain ridges and valleys; the mountains are mostly wooded, and the valleys wide and fertile, producing rich crops of rice. Cattle, sheep, pigs, goats, poultry, rice, pepper, camwood, and ivory are plentiful. The species of palm, *Elais Guineensis*, is very abundant, and furnishes the palm-oil of commerce, extracted from the seed or nut. Thousands of tons of oil are annually sent to the ports of London, Liverpool, and Bristol, for the manufacture of composite candles. The natives of the neighbourhood, called Kroomen, are an industrious race, very expert seamen, and well known to traders from the Gambia to the equator. The whole country is divided into three kingdoms, namely Cape Mount, with the towns of Conseca and Kingston; Sanguin, with its port Bassa; and a negro kingdom near Cape Palma, inhabited by the Settra Croo tribe. The Grain Coast comprises most part of the Republic of Liberia.

The *Ivory Coast* occupies the countries between Cape Palmas and Cape Three Points, a distance of nearly 400 miles. It was so called from the tusks of the African elephant formerly exported from it in large numbers. In this part the high land of the interior does not come close to the beach, but is divided from it by a low tract, about 10 or 12 miles wide on an average. This part of Guinea is inhabited by a number of small negro tribes.

The *Slave Coast* begins on the west at the Rio Volta, which empties itself into the Gulf of Guinea, near the meridian of Greenwich: it extends eastward to the neighbourhood of the river Formosa, or Benin, a distance of more than 400 miles along the sea-shore. The Rio Volta, which comes down from a great distance, is a broad river in the interior, but towards its mouth it divides into several branches, and forms a kind of delta. The shores of this coast are flat and low, and partly rendered inaccessible by sandbanks. They are covered by extensive salt-marshes and numerous lagoons, traversed by several rivers, among which the Lagos is the most considerable. The interior is partly fertile savannahs and partly forest. It is divided between the kingdoms of Dahomey, Ardrah, and Lagos. Dahomey occupies the western portion, lying contiguous to the country of the Ashantees. Its capital, *Abomey* (7° 12′ N. lat.), lies in the mountain region, and is stated to contain 30,000 inhabitants. *Calmina*, 15 miles S.E. of Abomey, has 15,000 inhabitants. *Whydah* is a town on the shore, being the first city in the state for commerce, though second in population (15,000). The medium of exchange is the cowrie shells. It is situated in 6° 17′ N. lat. and 2° 5′ E. lon. The province of Whydah borders on the Gulf of Guinea, in 0° 30′ N. lat. and 2° 10′ E. lon. It is highly fertile, and the inhabitants manufacture and dye good cloths, which, with gold-dust, palm-oil, ivory, and slaves, they exchange with American and Portuguese traders for European manufactures and other produce. Many slaves were formerly exported from this district, hence the name of this part of the coast. The chief town is Griwhee, about 8 miles inland. Several small states lie eastward in the basin of the Niger.

Benin is a maritime state between lat. 4° and 9° N. and lon. 4° and 8° E., bounded by Dahomey, Yarriba, the Lower Niger, and the Bight of Benin. Area, 50,000 square miles; population, unknown. The country is well watered, and extremely fertile. Principal rivers, the branches of the Niger at its delta. The religion, government, and customs are similar to those in Ashantee and the rest of Guinea. The export trade is in salt, palm-oil, blue coral, jasper, leopard skins, pepper, native-dyed cloths, and slaves. The town of Benin, capital of the kingdom, is in 6° 20′ N. lat. and 5° 50′ E. lon., at some distance from the right bank of the river Benin. It occupies a large area, but the population is not probably more than 15,000. It is a mart for live stock, yams, cotton, ivory, and European wares. The king's palace is of great extent, including several squares, with ranges of apartments for officers of state, servants, and others, and with long galleries supported by wooden pillars. The traveller Belzoni died in the town in 1823.

GUINEA, NEW. See New Guinea.

GUINEA, a gold coin formerly in use in England, and so named from having been first coined of gold brought from the coast of Guinea by the African Company in 1663. The value of the guinea varied at different times, but in 1717 it was fixed at 21*s.* Guineas have not [illegible]d in England [illegible] the [illegible]ue of 1817. *Spade guineas*, or *Spade-ace guineas*, are guineas coined in the reign of George III., towards the close of the last century, and characterized by the royal arms being engraved on a shield in the form of an ace of spades.

GUINEA-FOWL (*Numida meleagris*), a well-known domestic game bird belonging to the order Gallinæ. It has the head and neck naked, the crown of the head adorned with a hard black casque, and the base of the bill furnished with large wattles. The general colour of the plumage is pearly-gray, mottled all over with small white spots. The home of the guinea-fowl is, as the name denotes, Guinea, on the west coast of Africa, the country lying between the Gambia and Gaboon rivers. In a wild state this bird is usually met with in small flocks or families, but at some seasons these unite to form large companies. It is a restless and quarrelsome bird, and very noisy, constantly uttering a loud harsh cry resembling the syllables *ca-mac*, *ca-mac*, frequently repeated. The guinea-fowl is partial to marshy places, where it finds abundance of worms and insects, on which it is fond of feeding; it also eats grain and fruits of various kinds. It roosts in trees, and the female deposits her eggs, sometimes to the number of twenty, on the ground in the midst of a tuft of grass or a thicket. Darwin observes that the guinea-fowl has become perfectly wild at Ascension and in Jamaica.

Guinea-fowl, though not a source of profit to the peasant who rears poultry for immediate sale, are usually kept where there is proper accommodation, as much on account of the excellence and abundance of the eggs (which, though small, are well-flavoured) as for the sake of the flesh, which is prized in the London markets when the season of pheasant-eating ceases. The cock, little distinguished in appearance from the female, is an attentive and affectionate mate. He is not so polygamous as many of the game birds.

Retaining some of their original wildness, guinea-fowl dislike the confinement of a house. For the purpose of laying they prefer shrubberies, clover-meadows, or corn-fields, in which they will deposit their eggs, unless closely watched. The guinea hen is fruitful during the entire summer, but not earlier than May.

Other species of guinea-fowl are found in Africa. A peculiar species is the Crested Guinea-fowl (*Numida cristata*) from Sierra Leone. This species is remarkable for having the crown of its head adorned with a crest of decomposed feathers instead of a casque. Its plumage is blue-black, marked with numerous small gray spots; the primaries are yellowish-brown, and the edges of the secondaries white. The head and neck are bare, and of a livid blue colour, tinged in part with red.

GUINEA-PIG, a well-known domestic pet, is generally considered to be a domesticated variety of the Restless Cavy (*Cavia aperea*), a little rodent, native of Brazil and some other parts of South America. The name seems very inappropriate; probably guinea-pig is a corruption of Guiana-pig. The question as to the origin of the

guinea-pig is involved in some doubt. It is probable that it was domesticated in America before the discovery of the New World by Europeans. It differs somewhat from *Cavia aperea*. In the wild animal the prevailing colour is grayish-brown, while in the guinea-pig it is white, with black and orange-coloured spots. The guinea-pig is also slightly larger than the restless cavy. It is perhaps the most prolific of any of our domestic animals, the female producing from six to twelve young in a litter, and bringing forth several litters a year. The guinea-pig is valued only as a harmless pretty pet; neither its flesh nor its fur is valuable.

GUINEA-WORM (*Filaria medinensis*) is an internal parasitic worm belonging to the order NEMATODA, the type of the genus Filaria. The guinea-worm is long, slender, and cylindrical, varying in length from 6 inches to 10 feet, but not exceeding one-tenth of an inch in thickness. This parasite infests the subcutaneous tissues of the natives of hot climates. Having penetrated the skin a painful and often dangerous tumour is raised. From these tumours the embryos, hatched in immense numbers within the body of the female, escape into water. They now become parasitic in the little crustaceans of the genus Cyclops, and undergo metamorphosis. To return to the human host, in which they attain maturity, they must be drunk, Cyclops and all, by man. Several other species of Filaria are internal parasites in man. The life-history of a species found in human blood, *Filaria sanguinis hominis*, has been investigated recently by Dr. Manson. This parasite is the embryo of a mature Filaria living in the lymphatic vessels. The intermediary host Dr. Manson has discovered to be a species of mosquito.

GUIS'BOROUGH, a market-town of England, in the county of York, and one of the centres of the iron trade, is situated amid much pleasant scenery, 11 miles from Middlesborough on the North-eastern Railway, and 261 from London. About 6 miles north is the small harbour of Redcar, at the mouth of the Tees. The town was formerly celebrated for its alum works, originated by Sir Thomas Chaloner in the reign of Mary, but its prosperity now depends upon its ironstone quarries, and there are roperies, tanneries, and brickworks. The chalybeate spa is now disused. The ruins of an Augustinian priory, founded in 1120-29 by Robert de Brus, consisting chiefly of the east end of the church and of the Transition Norman gatehouse, possess great interest for the archæologist. The mouldings both of this and the windows of the choir aisles are beautifully executed. This church was the burial-place of the powerful family of De Brus, several stone coffins belonging to them having been excavated here, and among them, it is supposed, that of Robert Bruce, grandfather of the Scottish king. The parish church belongs to the Perpendicular period. An altar tomb in the porch is supposed to be the cenotaph of Robert Bruce, king of Scotland, or of his grandfather. The population of the town in 1881 was 5202; of the parish, 5671.

GUIS'CARD or **WISCARD, ROBERT** (1015-85), the famous Duke of Apulia, was one of the sons of Tancred de Hauteville. His three elder brothers had gained wealth and lands in Italy, and especially William, who had become Count of Apulia. Robert came later, but his ferocity and his astonishing personal courage and activity soon made him the equal of his brothers, and at their death he inherited Apulia, &c. His first step was to acquire Calabria by force of arms. He now sought the favour of the pope, who had excommunicated him, by acknowledging his nominal sovereignty and by paying tribute. With a younger brother, Roger, he next overran and reduced the whole of Sicily, which the pope had delivered into his hands. Roger was the first Norman count of Sicily. Robert had married his daughter to the heir of the Eastern Empire, and on the usurpation of Alexis Comnenus he hastened to support the right of his son-in-law, and inflicted a severe defeat on Alexis at Durazzo, 1083.

The Emperor Henry IV., smarting under his humiliation at Canossa, was at this time taking revenge upon his ancient enemy Hildebrand (Gregory VII.) Year after year he encamped before Rome, shutting Gregory up as a prisoner in his own city, until the malaria drove him and his Germans northward for the summer. At length an entry was made, and on 9th June, 1083, Henry was master of the city; and the pope held the Castle of St. Angelo alone, while Guibert, a nominee of Henry's, was crowned pope in his stead. Robert Guiscard had helped the pope liberally with money, but on the other hand Alexis had substantially supported his brother-emperor by way of opposing Guiscard. The latter yielded to the prayers of Gregory in this emergency, left his nephew Bohemond to prosecute the Greek war, and returned with a large force into Italy. Henry could not cope with these veterans, hardened by many years of perpetual combats, and led by the fiercest captain of the age. He retired three days before Guiscard arrived, in May, 1081, taking hostages for the fidelity of the city. The Normans soon overcame the resistance of the Romans, released the pope, and then fell upon Rome like a pestilence. So terrible was the scourge that the people rose against their brutal foe in a few days, and for a time by their better use of the vantage-points of the city they made some way against the Normans and their host. The remorseless Guiscard upon this gave the dreadful order to fire the city, and the pope looking on from St. Angelo beheld his city in flames, his subjects slaughtered by hundreds, the most horrible crimes committed in the public streets before his eyes upon defenceless women and children, and this by his own deliverers and friends! Thousands were sold as slaves. It is said with confidence that of all the horrors heaped upon Rome by Goth, Vandal, Greek, and German, this was the worst. The older part of the city was deserted and still remains uninhabited, and when better times came the people crept up towards the great fortress, leaving the once thickly populated Aventine and Cælian bare and desolate. The pope, hated by all and protected only by the guard of the Normans, fled from Rome to Guiscard's fortress of Salerno, near Naples, one of his conquests from the Saracens. Here he fulminated anathemas against his foes, but he never left it till his death in 1085. As for Guiscard he returned to his Greek war, and prosecuted it with energy and success. He died in Cephalonia two months after the pope, July, 1085, and his sons inherited his dukedom.

GUISE, the name of an illustrious French family, and one which exercised the predominant influence over that nation during the sixteenth century. It derives its name from the town of Guise, which is in the department of the Aisne, and is situated on the left bank of the Oise, 13 miles north-west of Vervins. The family was founded by *Claude* (fifth son of René II., duke of Lorraine), born in 1496, who was sent into France by his father in 1506, and was brought up at the French court, being made Duke of Guise in 1527. He attached himself to Francis I., whom he accompanied in his Italian campaign, fighting with distinguished bravery at the battle of Marignano in 1515, where he received twenty-two wounds. He subsequently distinguished himself at Fuenterrabia, in Picardy, and drove back the Germans from Champagne. He became the virtual head of the regency during the captivity of Francis I. at Madrid, and in 1542 he fought in Flanders under the Duke of Orleans. He treated the Protestants of Elsass with the most sanguinary cruelty, sparing neither sex nor age, and earned for himself the title of "the accursed butcher," by which he is still remembered in that country. His death, which was generally ascribed to poison, took place at Joinville on the 14th April, 1550. He had married Antoinette of Bourbon in 1513, by whom he had

twelve children. His daughter Marie became the wife of James V. of Scotland and the mother of Mary Queen of Scots.

François, second Duke of Guise, son of Claude, was born 17th February, 1519. He was one of the most illustrious generals of the age, his most considerable exploits being the defence of Metz, in 1552, against the army of Charles V., and the taking of Guines, Ham, and Calais from the English. Ably supported by his brother Charles, cardinal of Lorraine and one of the most powerful statesmen of the age, he was for some years the virtual sovereign of France. He inherited his father's hatred of Protestantism, and fought successfully against the Huguenots, retaking Rouen, which had fallen into their hands, and gaining the victory of Dreux in 1562, where the Prince of Condé, their leader, was taken prisoner. He was assassinated at the siege of Orleans in February, 1563.

Henry of Guise, the eldest son of Duke François, was born 31st December, 1550. He was present at the death of his father, and began life with more than the hereditary hatred of the house of Guise towards the Huguenots. At the age of sixteen he fought in Hungary against the Turks, and later distinguished himself at the battles of Jarnac and Moncontour, and compelled Coligny to raise the siege of Poitiers in 1569. He took charge of the massacre of St. Bartholomew, 24th August, 1572, commanded the troops told off to assassinate Admiral Coligny, and when at his orders the body of that veteran was flung out of the window he is said to have kicked it in the face. In 1575 he defeated the Huguenots near Château-Thierry, where he received a wound in the face, which earned for him the surname *Balafré* (scarred), a title that had also been borne by his father from a similar circumstance. In 1576 he became the head of the famous confederacy called the League, of which the avowed object was the defence of Catholicism, but which he worked with the object of raising himself to the throne. In the war of the three Henries he conquered Henry of Navarre, and was ultimately hailed by the popular voice "King of Paris," the king himself, Henry III., being reduced almost to a cipher. The king, however, had long felt his position intolerable, and had resolved on the destruction of the duke, who was assassinated by the archers of the royal guard at Blois, 23rd December, 1588. His brother Louis, the cardinal of Guise, was also assassinated the next day by the royal orders.

Charles, fourth Duke of Guise, the eldest son of the preceding, born in 1571, was kept a prisoner for three years after the murder of his father, but escaped in 1591. With his uncle he carried on the contest for a time against Henry of Navarre, but in the end submitted and received from that king the government of Provence. He was banished by Richelieu in 1631, and died near Siena in 1640.

Henry, fourth son of Charles, was born in 1614, and had become Archbishop of Rheims when the death of his brother caused him to succeed to the family estates and honours, and he thereupon quitted the church. He joined the league against Richelieu, and was condemned to death by the Parliament of Paris. He managed to escape to Brussels, and afterwards took refuge in Germany, where he remained until after the death of Louis XIII. At the revolt of Masaniello in 1647, he went to Naples and was elected king by the Neapolitans, but was ultimately captured by the Spaniards and carried to Madrid, where he was detained four years. He returned to Paris in 1652, and after a licentious and ill-ordered life died there without issue in 1664. The title then passed to *Louis Joseph*, who died of small-pox in 1671, and from him to his infant son *Francis Joseph*, who died in 1675, and the direct line thus became extinct.

GUITAR′, a musical instrument which, in various shapes, may be traced to the remotest periods of antiquity. The word is derived from the Greek *kithara;* and the terms *cittern* and *gittern*, used by the old English poets, are but corruptions of the primitive word.

The Spanish guitar we undoubtedly owe to the Moors. It is in fact an Arabic version of the lute, and appears in Spain towards the close of the eleventh century. The English and French guitar of the last century was wide and thin in the body, short in the neck, and strung with wire; in fact it was a modified CITHER, and in one of its forms yet lives as the ZITHER.

The modern guitar, which is of the Spanish kind, and differing little from the lute, consists of a body from 17 to 18 inches in length and 4 in depth, with both back and belly flat, of a circular sound-hole, and of a neck of about 16 inches, the latter carrying a finger-board divided by seventeen frets. It has six strings, three being of silk, covered with silver wire, and three of catgut. These strings fasten into a bar fixed transversely on the face of the instrument, and are pressed in with pegs, as in the case of the harp, &c.; and this bar serves also as a bridge, having a nut of brass or ivory, over which the strings pass immediately after leaving the pegs. The instrument is much esteemed in Spain and Italy.

The compass of this elegant instrument is from E below the bass staff to A above the treble staff, including all the intermediate tones and semitones. The strings are tuned curiously, the notes being E, A, *d*, *g*, *b*, *e′*. Music for the guitar is written an octave above the real notes. As a solo instrument it is ineffective, but its charming use in outdoor accompaniment is well known. The cheapest guitars are made in Germany, the best in France.

GUIZOT, FRANÇOIS PIERRE GUILLAUME, an eminent French statesman and historian, was born at Nîmes, 4th October, 1787. He was of Huguenot descent, and his father, a distinguished advocate, died on the scaffold in 1794, a victim to revolutionary suspicion. Madame Guizot fled with her son to Geneva, where young Guizot had eleven years' schooling. In 1805 the exiles returned to Paris, and here the charms of literature diverted M. Guizot from his proposed legal studies. His contributions to *Le Publiciste* led to an acquaintance, which in 1812 ripened into marriage, with the fair editress, Mdlle. Pauline de Meulan, although the lady was fourteen years his senior. In the same year the reputation M. Guizot had obtained won for him from the imperial government a professorship of modern history at the Sorbonne. In 1814, under the Bourbons, he was appointed secretary to the minister of the interior. With the exception of the interval of Napoleon's return and a temporary retirement in 1816, he held office until 1820, when, together with his colleagues, he retired, and for the next ten years was occupied in producing the historical works on which his literary fame chiefly rests. After the revolution of July, 1830, he became provisionally minister of instruction, and afterwards minister of the interior, and for a short time represented his country in London as French ambassador. In 1840 he became minister of foreign affairs in the cabinet of Marshal Soult, but was himself the leading spirit of the administration, and continued in office till the revolution of February, 1848, put an end to the monarchy and to M. Guizot's political career. After the fall of Louis Philippe, M. Guizot sought a refuge in England, where he remained for three years. Returning to France after the *coup d'état* in 1851, M. Guizot found a tide of unpopularity had set in against him, which rendered unsuccessful his efforts to regain a seat in the legislative body. He then resigned himself to the comparative leisure of private life, at his country seat in Val Richer, near Lisieux, in Normandy, whence he only came forth in the discharge of his functions either as a member of the French Academy or as a leader in the conferences of the Protestant Church in France. He died 12th September, 1874, in his eighty-seventh year.

M. Guizot's principal literary works are the "Course of Modern History," the "History of Modern Civilization in Europe," his "History of France," written chiefly for the young, and a translation of Gibbon's "Decline and Fall," with valuable original notes. He was also a profound student of English history and literature, and wrote a "History of the English Revolution" and "Critical Notes and Essays upon Shakspeare." His writings are distinguished by solid erudition, a scrupulous love of truth, a careful collection of evidence, and excellent judgment in its use. In political life M. Guizot followed what he called the "conservative" policy; he was incessantly in dread of tumult; he saw attack and commotion everywhere; and he endeavoured to avert revolution by the very means which were most likely to bring it about. His great receipt for preventing revolution was, not by extending the suffrage, but by restricting it, and he proposed to found the throne of constitutional liberty on a select *bourgeoisie*—few in number, moderate in disposition, easily conciliated by their interests. The revolution of 1848 might have been avoided had he been willing to extend the suffrage to the vast mass of peasant proprietors who form the majority in France, and who, he ought to have seen, feared and hated revolution quite as much as he could himself. His advice to Louis Philippe to crush the rebellion of 1848 by military force was significant of the principle of "authority" he was ever anxious to assert. If, as he appeared to regard it, his mission was to avert revolution, it was a failure, and one to the importance of which every page of present French politics bears witness. No French government has ever had such a chance of living as the monarchy of July had, which M. Guizot destroyed. He incurred considerable unpopularity in his conduct of the Eastern question, which resulted in the treaty of 14th July, 1840; and was equally unfortunate in the Pritchard controversy with England in 1844, and in the discreditable affair of the Spanish marriages in 1846. ("M. Guizot in Private Life," by his daughter, Madame de Witt; translated by Mr. C. M. Simpson, London, 1880.)

GUIZO'TIA is a genus of plants belonging to the order COMPOSITÆ (tribe Helianthoideæ). There are three species, all natives of tropical Africa, but one (*Guizotia abyssinica*) is largely cultivated in India, as well as in its native habitat, for the sake of oil expressed from the fruits or so-called seeds. This oil-bearing species, called *ramtil* in Bengal, is an erect leafy herb from 1 to 3 feet high, with large bright yellow flowers and opposite toothed leaves. The ramtil-oil is sweet tasted, and though inferior to that produced by SESAMUM, is used in a variety of ways, in food, medicine, and as lamp-oil. It is very cheap. No manure is necessary; the crop is cut three months after sowing, and the seed thrashed out with a stick. An acre produces about 2 bushels.

GULES is the heraldic name for the colour red. In engraved representations of coats of arms *gules* is represented by close perpendicular shading.

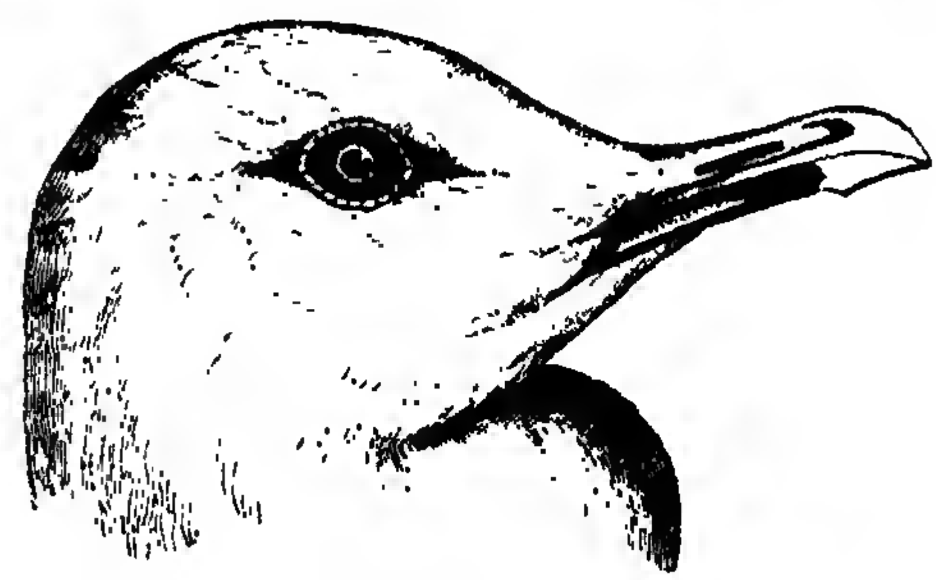
GULF. See BAY.

GULF STREAM. See ATLANTIC OCEAN.

GULF-WEED (*Sargassum bacciferum*) is the name given to the particular kind of seaweed which floats on the surface of that calm part of the Atlantic Ocean which is bounded on the north by the Gulf Stream and on the south by the equatorial current running westwards. Columbus and his crews, on the 16th September, 1492, first came upon those immense plains of seaweed, which they called the Mar de Sargaço, "and which occupy a space in the Atlantic almost equal to seven times the extent of France. The aspect of these plains greatly terrified the sailors, who thought they might be coming upon submerged lands and rocks; but finding that the vessels cut their way well through this sea-weed, the sailors thereupon took heart" (Arthur Helps). The stem of the gulf-weed forms numerous branches, with long narrow-toothed leaves and great quantities of air-receptacles, which have the appearance of small berries, and give to it the specific name *bacci-ferum* (berry-bearing). The fruit-bearing receptacles are collected in small bundles where the leaves spring from the stem, but these are not produced in the floating condition, the plant propagating itself by buds. There are several species belonging to the genus Sargassum, natives of tropical and subtropical seas. A few pieces of the gulf-weed are occasionally thrown upon our shores, carried along by the Gulf Stream.

GULL, in its widest sense, is the name for the group of sea-birds forming the family Laridæ. This large family may be divided broadly into two subfamilies—Larinæ, the true gulls, and Sterninæ, the terns. The Larinæ will be alone considered in the present article.

The gulls are powerful on the wing, and easy and graceful in their aerial movements; they often rest floating on the water, but they do not dive; yet they skim off floating substances, such as dead or living fish and the putrescent exuviæ of the sea, with great address. Some are predatory in their habits, and, like the sea-eagle, force the more feeble fishers to disgorge their booty. In most species the plumage undergoes a decided change of colour on the approach of winter. The young differ from their parents, and do not acquire their perfect colouring until the second or third year. The gulls breed in large companies and in various situations, according to the habits of the species, some selecting the ledges of cliffs, others choosing flat and exposed rocky islands, while others seek the marshes and



Head of Common Gull.

pools of the more inland parts, and form their nests among aquatic herbage. These birds have a very wide geographical distribution, and are found in every part of the world, and under a great variety of climate; many, especially of the larger species, are inhabitants of the higher latitudes.

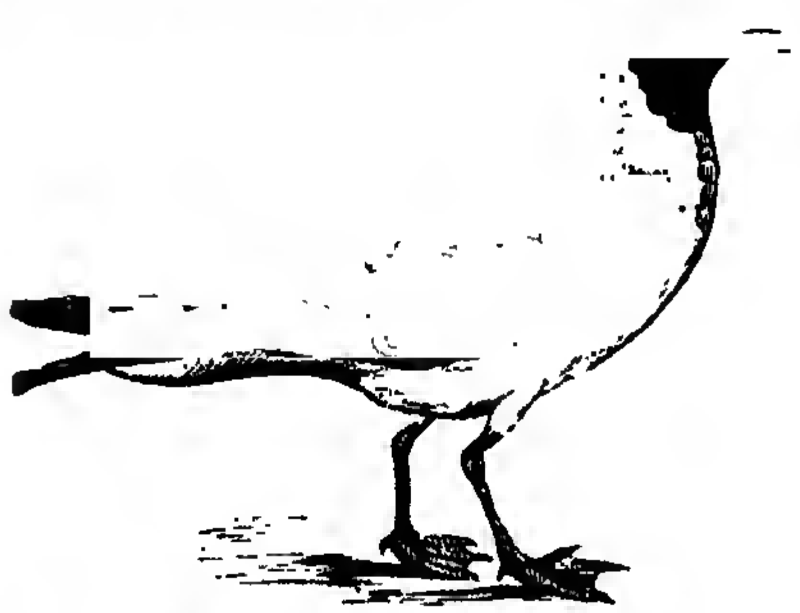
In the gulls the wings are long and pointed. The bill is variable in form, but generally is stout and curved; the nostrils form linear or oval slits in the sides of the upper mandible without any trace of tubular structure (see cut). The feet, which are placed moderately forward, so as to enable the birds to walk with ease, are powerful; the three anterior toes are long and united by a complete membrane, and the hinder toe is small and elevated on the back of the tarsus; sometimes the hinder toe is absent. The genus Larus contains a great number of species, forty-three in all, varying greatly in size and plumage. The Common Gull (*Larus canus*), one of the most abundant of the British species of this family, occurs also in most parts of Europe and in North America. It is about 18 inches in length, and is of a pearl-gray colour above; the head and neck and lower surface are white; the secondaries and tertiaries are tipped with white, and the primaries are black on the outer webs, with a white patch near the tips of the first and second. The bill is greenish-gray, becoming yellow towards the tip, and the feet are of a dark greenish

colour. This bird is common on most parts of our coasts throughout the year. It may be seen walking about upon the shore or sandbanks, engaged in picking up any portions of food left by the tide, or taking short flights over the shallow water to seize upon small fishes and other floating objects. It may also frequently be seen in some districts at a distance of several miles from the sea, following the ploughs in order to pick up the insects and grubs; and it is by no means uncommon for it to advance many miles along the course of a tidal river. The common gull breeds on the ledge of a cliff, wherever the coast presents such conveniences; on flat shores it breeds in the marshes or on low sandy islands. The nest is rather large, and is composed of seaweeds and grass; the female lays two or three eggs.

The largest species of gull is the Great Black-backed Gull (*Larus marinus*), peculiar to Europe and North-eastern America, and well known on our coasts. It attains

Black-backed Gull (*Larus marinus*).

a length of 30 inches. It is very predaceous in its habits, destroying not only fish, but also the eggs and the young of eider-ducks and other birds. The Lesser Black-backed Gull (*Larus fuscus*), another British species, greatly resembles the former species, but is smaller. The Herring Gull (*Larus argentatus*) derives its name from its partiality for small fish, in pursuit of which it approaches the boats of the fishermen with great boldness. It is a widely distributed species. It usually breeds in company with *Larus fuscus*, from which it may be distinguished



Black-headed Gull (*Larus ridibundus*).

by the lighter colour of the back and wings. The Little Gull (*Larus minutus*) is the smallest species of gull, measuring little more than 10 inches in length. It is rather a rare bird in this country, but is more common in Southern Europe. The Black-headed or Peewit Gull (*Larus ridibundus*) is common in our islands, retiring in summer from the sea to breed in inland marshes, after which it returns in flocks to the coast. Its note is a hoarse cackle. Its food consists of fishes, crustaceans, and the larvæ of beetles and other insects. The Glaucous Gull (*Larus glaucus*) is another British species, having also a very wide range. Many other species of the genus Larus are known.

The Kittiwake (*Rissa tridactyla*) is an example of a small genus of gulls, in which the hinder toe is represented only by a small tubercle, without any trace of a claw. It is abundant on many parts of the British coasts, and extends hence to the highest northern latitudes. The kittiwake has the plumage of the back and wings delicate French gray, the outer margin of the first primary and the tips of the succeeding ones black, and the head, neck, and lower surface pure white; the bill is greenish-yellow, with the interior of the mouth orange. The wings are very long and pointed, crossing, when closed, above the tail. This bird breeds on the ledges of lofty and precipitous cliffs, forming a nest of seaweeds, and usually laying three eggs. The other species of this genus, *Rissa brevirostris*, is confined to the North Pacific.

The genus Xema contains only two species, distinguished by their forked tail: *Xema sabinii*, breeding in North America and Siberia, and occasionally found in Britain; and *Xema furcatum*, known only from the Galapagos Islands. The Ivory Gull (*Pagophila eburnea*) is the only species of the genus Pagophila. This gull is about 16 or 18 inches in length. It is distinguished by the pure and delicate white colour of its plumage; the bill is yellow and the legs jet black. According to the views of Saunders, the most recent authority on this group, there is but one other genus, Rhodostethia, containing a single species, the Roseate Gull (*Rhodostethia rosea*), distinguished by its wedge-shaped tail and rose-coloured plumage. The Skuas (Stercorarins), frequently ranked as a separate subclass, are noticed elsewhere.

GUM is a term applied to exudations from plants which dissolve in water to form a liquid or a gelatinous substance, but which do not dissolve in alcohol of 60 per cent. Treated with sulphuric acid they are changed into sugar; with nitric acid they yield mucic and oxalic acids. Gums differ in their chemical composition, but are chiefly composed of one or more of the hydrocarbons—bassorin, arabin, and cerasin. Bassorin is a pure hydrocarbon, the others are combined with lime, and arabin contains also some potash or magnesia. Gums are formed by chemical changes occurring in the cells and cell-walls. They exude from the stem, branches, or fruit. They may readily be distinguished from gum-resins by the resinous portions of the latter being soluble in alcohol but not in water.

The principal gums are Arabic (including Senegal, &c.) and Kuteera (Indian tragacanth), derived from species of acacia; tragacanth, from a species of Astragalus; cherry gums, from species of plum and almond.

Gum-arabic occurs in pieces from the size of a pea to that of a walnut or larger, which are irregular in shape or roundish or angular, varying in colour from a light straw to a deep red, almost without odour, and of a mawkish taste. The specimens differ considerably in colour, even when obtained from the same species, and the different descriptions are known by the names of Turkey Picked, Senegal, Gedda, Barbary, Australian, Cape, East Indian, &c. They are all derived from various species of acacia. Picked Turkey and Senegal are derived from *Acacia Senegal*, which forms vast forests north of the Senegal River; it is also found in Nubia and Kordofan.

Gums of inferior quality are obtained from various species of acacia in India, Australia, and the Cape of Good Hope; but they nearly all contain bassorin, which does not dissolve fully in water, or form a homogeneous solution.

The finer varieties of gum are used in medicine for their demulcent and emollient properties, and in affections of the throat and intestines they serve a useful purpose in protecting the membrane from air or the irritation of acid solutions. They are also used by confectioners in the

manufacture of lozenges, &c. The coarser qualities are used to give lustre to crape and silk, in calico printing to give consistence to the colours and prevent them spreading, in painting, ink-making, and in the making of an adhesive paste for labels, &c.

Gum, when in powder, is often adulterated with starch, the presence of which is detected by tincture of iodine; or when cold water is used for the solution of the gum, the starch will remain undissolved. The mucilage made with cold water is not only purer, but keeps better, and for all purposes for which it can be used is preferable to that made with warm water, which is the common method.

The chief substitutes for gum are made by roasting or baking starch, and are described under DEXTRIN.

GUM-BOIL, a painful form of abscess usually caused by the irritation of a decayed tooth. In the majority of cases the affection is of a superficial character, and when suppuration takes place it is quickly followed by the breaking of the boil, which readily heals. Occasionally there are cases of a more severe character, attended by great swelling and pain and considerable disturbance of the general health; and where the matter formed cannot find a ready exit it may give rise to caries or necrosis of the subjacent bone. The treatment of gum-boil consists in the application of warmth by means of a poultice applied to the cheek and a frequent rinsing of the mouth with hot water. The diet should be light and the bowels should be kept open. When matter appears it is generally a good plan to give it vent by lancing the gum.

GUM'MIC or **ARABIC ACID**, an organic acid which, in combination with lime and potash, forms the gum so well known in commerce as gum-arabic. The formula is $C_{12}H_{22}O_{11}$; it is obtained as a flocculent precipitate, when solution of gum-arabic is mixed with hydrochloric acid and alcohol. It forms soluble salts with the alkaline earths, and insoluble salts with several metals, which are called arabates. Gum-arabic contains about 70 per cent. of this acid.

GUM-RESINS are secretions of plants, which are produced in the greatest quantity, and most perfectly elaborated, in warm countries. They are obtained chiefly from trees and shrubs of particular tribes of plants, rarely from herbaceous plants, except the large herbaceous Umbelliferæ, which yield the fetid gum-resins. They either exude spontaneously, or are procured by incisions of the stem and branches. When they first escape to the surface they are fluid and of a light colour, but gradually harden, and become of a deeper hue. This milky juice is formed of resin and essential oil, held suspended in water charged with gum and other vegetable matters. The name gum-resin is not very definite. Most gum-resins possess a strong odour, which in many instances is disagreeable, such as that of asafœtida, with a warm acrid taste, and by application to the skin for any considerable time they cause redness and inflammation.

Gum-resins are with difficulty soluble in the animal juices; yet as they must be assimilated before they produce their characteristic effects, they require to be used for some time before the secretions of the body acquire their peculiar odour. They influence the secretory and excretory processes, which they rouse to continued action. They also act upon the skin as sudorifics, and more permanently than the volatile oils. They possess considerable antispasmodic powers, and hence are much used in nervous complaints. They greatly promote digestion when the stomach is feeble, owing to a defective supply of nervous energy. Their utility in the treatment of hysterical and other paroxysms is very much increased by administering them in a state which admits of ready solution in the gastric fluids; hence the acetous preparations of them are much more potent than any other form. They may be administered either by the mouth, or, in case of spasm closing the teeth, or the patient being refractory, in the form of clyster, the dose being doubled in the latter instance.

Gum-resins are likewise applied externally, owing to their rubefacient powers, in the form of liniments or plasters in spasmodic and rheumatic affections, and also to assist in dispersing indolent tumours. Gum-resins should be kept in cool well-closed places, to prevent the evaporation of their volatile principles. The chief gum-resins are the following:—AMMONIAC, ASAFŒTIDA, BDELLIUM, FRANKINCENSE, GAMBOGE, MYRRH, OPOPONAX, SCAMMONY, and STORAX.

GUM-TREE. See EUCALYPTUS.

GUN, a term applicable in the present article to the great artillery (cannon, carronades, howitzers, and mortars) used in war, as distinguished from the various kinds of rifles, which, together with all other descriptions of portable fire-arms, will be treated of under SMALL ARMS. The name of ordnance is frequently applied to heavy guns, and was probably derived from the *Compagnies d'Ordonnance*, instituted in 1448 by Charles VII. of France. The earliest record of the use of such guns is in the invasion of Scotland by Edward II. in 1328, and at the battle of Crécy in 1346. Then, and for the whole period down to the Crimean War, the favourite material for guns was copper, brass, or bronze, though from about the middle of the seventeenth century cast iron was in vogue for the heaviest kinds of ordnance—ship and fortress guns, &c. Long, however, before the smelting of iron ores was fully understood, very creditable pieces were cast in the softer bronze. At the Birmingham Museum, Woolwich Rotunda, and the Tower of London there are some very fine specimens of old Indian brass ordnance hundreds of years old, and numbers of curious European field-pieces, including (at Woolwich) two three barrelled cannon taken at Malplaquet. At the Tower may be seen some guns of the early part of the sixteenth century, made of wrought-iron plates put together longitudinally and hooped with wrought iron. Another hundred years saw considerable improvement, and in the Thirty Years' War (1618–48) Gustavus Adolphus not only possessed himself of a very numerous artillery, but used his guns—sometimes to the number of 200 in a single engagement—with conspicuous and decided advantage. [See ARTILLERY.] From this time to that of the Peninsular and Napoleonic wars the chief improvements were in the nature of increased mobility in the case of field guns, but progress in all other respects was slow, and the Crimean War was fought with guns of the same construction as in the days of Nelson, Wellington, and Napoleon I. The heaviest gun used was one brought from the fleet to assist in the bombardment of Sebastopol, and weighed 64 cwts. It was considered a huge piece, and the fate of the Russian fortress was regarded as sealed when 68-pounder shells were hurled into it from this redoubtable cannon. It was, however, the eve of a remarkable transition period, and in the next twenty-five years more progress was made in the manufacture of heavy guns than had been witnessed in the previous four centuries. The heaviest gun of the Crimean period (1856) was a little over 3 tons. By 1863 this had grown to 5 tons, and ten years later, in 1873, the *Devastation* and the *Thunderer* were armed with 38-ton guns; in 1876 the *Inflexible* was mounted with 81-ton guns, and in 1884 there were being manufactured 120-ton guns, which, by hydraulic appliance, could be manipulated with as much or more ease than one of the old 32-pounders. A single projectile from this 120-ton weapon exceeds the weight of the full double broadside of a 74-gun ship in Lord Nelson's day.

The first impetus given to the production of powerful ordnance was the successful application of rifling to small arms. While smooth-bore muskets were in vogue, which were not destructive at any greater distance than from 100 to

200 yards, smooth-bore cannon could be safely employed; but when the introduction of rifled small arms rendered it easy for infantry to pick off the gunners at their guns at long ranges, governments became desirous of securing rifled ordnance of an effective character. The value of the principle had long been known to some extent; for a gun rifled with nine grooves, and dating from 1615, may be seen in the museum at St. Petersburg. In 1661 the Prussians tried a gun rifled in thirteen shallow grooves; but the main object of these early attempts was to find space for the reception of the foul residue produced by discharging the gun, and thus to diminish the friction of the shot. The rifling was therefore in straight grooves, and it was not till our own times that guns with a spiral turn were successfully made. The Emperor Napoleon III., after the Crimean War, rifled his bronze guns, and when, at Magenta and Solferino, in 1859, their newly acquired powers were first displayed, the long day of smooth-bore guns rapidly declined. In England, from 1858 to 1862, about £3,000,000 sterling were spent in re-arming with rifled ordnance, first on the muzzle-loading, but latterly on the breechloading principle. Outside the government factories private constructors entered keenly into the competition, the contest being eventually narrowed down to a duel between the productions of Sir William Armstrong and Sir J. Whitworth. The whole question was extremely complicated, and had to be judged by the average superiority of one gun over another. Some £50,000 were spent in experiments by what was called the Armstrong-Whitworth Committee of 1864, and the decision on the average merits of the guns tried was given in favour of Armstrong, who from that time forth may be said to have had the use of the government factories as well as his own for the development of his system, the basis of which was the building up of guns by wrought-iron coils, as against the solid steel of Whitworth. The early Armstrongs were breechloaders, but notwithstanding their good qualities they developed defects of a serious character—getting out of order at critical moments, and causing numerous accidents to the gunners. A strong prejudice consequently sprang up against them as "scientific toys," and gunners became nervous of a weapon which could "shoot out of both ends." The battle of the systems resulted, soon after 1870, in a reversion to muzzle-loading, and upon this principle all our ordnance, from field guns to those of 80 and 100 tons, was constructed during the next few years. The method of making heavy guns was now supposed to have reached some degree of finality, when, in 1878, public attention was loudly called to some new guns which had been constructed by the firm of Sir William Armstrong, which, weight for weight, gave more than twice the power of any other ordnance at that time existing.

There then ensued another experimental stage, which eventually resulted in a further and more entire remodelling of our constructive systems, including the re-adoption of breechloading guns. The changes thus developed have gradually placed us in possession of the most splendid and effective ordnance in the world; and it is worth while, therefore, to look at the early experiments of 1878, by which these important results were achieved. The first experimental guns in which the new features of construction were combined were the 6-inch Armstrong guns of 77 cwts.—that is, 3 cwts. *less* than 4 tons in weight. Fired for velocity it was found that 70-lb. and 64-lb. projectiles could be propelled with a muzzle velocity of respectively 2000 and 2070 feet per second. (The velocity of sound is about 1125 feet per second, and the speed of the moon in her orbit is 1614 feet per second.) The speed attained by the 70-lb. shot from this gun enabled it to penetrate 8 inches of iron at a distance of a quarter of a mile. To appreciate the value of attaining such a power, it must be remembered that a high initial velocity given to a projectile meant more than a heavy blow upon the adversary: it meant longer effective range and better shooting at all ranges; and moreover, that at any range whatever the new gun would be much more likely to strike an object, because the path of its projectile through the air was less curved, and therefore less likely to pass over the mark. To further test its penetrative power, the 6-inch gun was loaded with an 80-lb. shot and a charge of 36 lbs. of powder. The 10 lbs. extra upon the shot decreased its velocity to 1919 feet; but the projectile penetrated a target of a little more than 11 inches of solid iron.

These results were demonstrated in 1878, and the fact that in 1863 the heaviest gun in the service, the 68-pounder of 5 tons 12 cwts., could make no impression on the 4½-inch plates of our earlier ironclads of the *Warrior* type, will give some little idea of the extraordinary development that had taken place in the art of destruction. A more remarkable comparison might be made between the marvellous performances of the 6-inch Armstrong gun above stated and the American 19½-ton smooth-bore of 15 inches—regarded even in 1867 as a prodigy in ordnance. With a 60-lb. charge the shot from this 19½-ton gun was utterly foiled by an 8-inch target, and with 100 lbs. only just succeeded in penetrating it.

Equally remarkable results were obtained with an Armstrong gun of 8-inch calibre, weighing 11 tons 9 cwts. The 10-inch Woolwich gun of 18 tons could penetrate the 9-inch armour of the *Hercules* at 500 yards distance; but the same projectile was stopped by a target equivalent to the 12 inch breastwork of the *Thunderer*, *Devastation*, or *Glatton*, even if placed close to the muzzle of the gun. The shot from the new Armstrong 8-inch gun would pass through the armour of the *Hercules* at 3000 yards range, and clean through the breastwork of the *Thunderer*, *Devastation*, or *Glatton* at 2000 yards. Yet the 10-inch Woolwich gun weighed 6½ tons more than the new Armstrong 8-inch gun. And again, the Woolwich 25-ton gun, of 11-inch calibre, would pierce the *Thunderer's* 12-inch breastwork at 500 yards, but failed to get through the 14-inch armour of the turrets—an achievement only accomplished by the 35-ton gun of Woolwich make. The new 8 inch Armstrong gun would not only go through the *Thunderer's* breastwork at 2000 yards, but would penetrate the 14-inch plates of the turrets. That is to say, a gun constructed on the later principles of artillery science, and weighing a little less than 11½ tons, was far more powerful than a Woolwich gun of 25 tons, and equalled in penetration a gun weighing 35 tons; and this with the extremely moderate pressure of 17 tons per square inch on the chamber of the gun.

The steps which led to this increase in the powers of heavy guns may be classed as—(1) improvement in gunpowder; and (2) alterations in the material and mechanism of ordnance.

(1) The modifications in the manufacture of powder within the last twenty years have been little less remarkable than those which have been witnessed in the art of gunmaking. The powder used in the Crimea, and indeed for years after, was the same as at Crecy, and was somewhat justly regarded as an explosive. Now it is simply a substance which burns with great rapidity, the products of combustion consisting of vapours and gases, the latter occupying roughly about 280 times the volume of the powder before ignition. It seems curious to speak of the time occupied by the ignition of a charge, the explosion of which is apparently instantaneous on the firing of the fuse; but as a matter of fact, the ignition occupies a definite period of time, varying according to the peculiarities of the powder, which may now be made in small grains of the size of coarsely ground pepper, or in lumps of from 8 to 12 oz. each, known as pebble or prismatic powder. The difference between gunpowder and a true explosive, such for instance as gun cotton, is easily illustrated by the

action of a solid cube of each. With gun cotton detonation and the conversion of the whole into gas are practically instantaneous, whatever the size of the mass; while with a solid cube of powder the exterior only of the lump burns and gives off gas until the whole is consumed. No gun can be made which is not liable to burst if the explosion of the charge be too violent and instantaneous. A charge of 400 lbs. of gun cotton, instead of gunpowder, would not only damage, but blow to pieces the strongest piece of ordnance. The same amount of very fine-grain powder would explode so violently as to set up a pressure of from 50 to 60 tons per square inch, a force calculated to crack and seam the bore of the gun, and render it useless or dangerous for any further work. Projectiles, moreover, for large guns are almost always hollow, so as to contain powder or shot, as in the case of shrapnell; and so great a pressure would most likely break in the base of the shot and cause it to explode within the gun, to the much greater damage of friends than foes. If, however, the 400 lbs. of powder be in large lumps or cubes, its complete ignition in the gun is slower than that of small grains, for exactly the same reason that a large lump of coal is more slowly consumed than the same weight of coal broken into small pieces. The explosion of the powder, whether in large or small grains, is but momentary, but with large grains the ignition is so *comparatively* slow that the projectile is moving before the powder is fully ignited. Then ensues a contest between the increasing volume of the gas, tending to raise the pressure, and the growing space behind the advancing shot, tending to relieve it. The shot is ultimately ejected from the gun, not with the transient force of a blow, such as would result from a too violent explosion, but with the force given by a prolonged and increasing push. In making a gun it follows that regard must be had to the weight of the shot to be moved and the charge intended to be used. The length must then be such that the powder will be fully ignited and its maximum pressure exerted just before the shot leaves the gun. The projectile is thus swept out with the utmost possible velocity, but obviously every inch of barrel, after the full effect of the powder has been produced, is a source of unnecessary and injurious friction; while, if the gun be too short, a great deal of powder will simply be wasted by being blown out unconsumed. By the use of pebble powder pressure in the gun is brought down to about 16 or 17 tons, with at the same time a far more powerful impetus to the shot.

The effects produced by Sir William Armstrong in 1878 were mainly the results of an effective use of slow-burning powder. First of all his guns were *chambered*, that is, the portion of the bore which contains the powder was enlarged so as to increase the possible charge; and the guns were then lengthened, so that the whole might be fully ignited before the projectile was ejected, thus utilizing the full force of the increased charge. In the battle of the systems which raged so fiercely prior to the adoption of muzzle-loading in 1870, perhaps the most remarkable thing was the circumstance that while there is now little doubt that the advocates of breechloading were on the right side, the reasons originally advanced by them were mostly fallacious. The real cause which rendered breechloading an absolute necessity was the improvements effected in connection with powder. All these improvements took the form of larger charges of slower-burning powder and increased length of bore, and there were then two horns of a dilemma for muzzle-loaders. First, the guns had to be made so long that loading from the muzzle, especially in the turrets of ironclads, became practically impossible. Secondly, the slow powder cannot be made to burn in the most effective manner unless the projectile be held fast by a strong band, which prevents it from moving till a pressure of about 2 tons is set up in the chamber. This can only be done in breechloading guns, for if the shot is inserted at the muzzle it must of necessity be smaller than the bore, and moves off at the moment of first pressure; while if put in at the enlarged breech it can be surrounded with a coating or rings of soft metal, which sufficiently retard its progress, effectually seal the escape of gas, and at the same time fit into the grooves of the rifling and impart the necessary rotation. The conclusion was inevitable, and in 1882 the British government commenced the renewal of all its ordnance on the breechloading principle. For the same reasons, however, the old short breechloaders of the Continent became obsolete, and foreign governments which for years had possessed guns of breechloading type were equally compelled to re-arm.

(2) *Alterations in the Material and Mechanism of Ordnance.*—The first important departure from centuries of established usage in making heavy guns was, as already indicated, the adoption of rifling. As pointed out in our article on GUNNERY, the chief gain insured thereby was accuracy, for it was found that when a definite rotation was given to the shot, its chance of hitting a mark at considerable range was immensely increased. With smooth-bore guns the shot fitted loosely in the barrel, and on being fired jumped from one side to another, its ultimate direction being opposite to the last bump. In rifled guns, on the other hand, the bullet could be tightly centred in the barrel and ejected with far more certainty in a definite direction. Conical projectiles could also be used, having the advantage of going point foremost to the mark, with the steadiness which quick rotation imparts. If, moreover, it could be insured that a shot will proceed point foremost, the head could then be adapted by extra hardness for penetrating power, or a fuse might be fixed so as to explode the shell on its point striking an object.

The nature of the grooves with which a gun is rifled depends chiefly upon whether muzzle-loading or breechloading is intended. If the former, the shot, having to be pushed down the gun from the front, must be smaller than the bore; while, if put in at the breech, it may be larger. In the first case the grooves are comparatively few and deep, and the shot is provided with studs, which fit into the grooves and guide it in its rotatory course. There arose the disadvantage, however, of there being considerable "windage" or escape of gas around the shot, between it and the gun, often to the very serious erosion of the bore. Besides which, the studs frequently "hitched" or in some other way retarded the progress of the shot, and were either themselves torn off or they injured the grooves of the gun. The bombardment of Alexandria in 1882 was carried out with muzzle-loading ordnance having for the most part studded projectiles, and the splitting of two of the 18-ton guns on board the *Alexandra*, and more or less mischief to several others, testified to the dangers attending the use of studs and deep grooves. The difficulty had been met to some extent by fixing a flanged copper disc to the base of the projectile. Under the first pressure of firing, it was found that the disc of softer metal expanded and cut off the windage entirely. The flange, moreover, expanded into the grooves of the gun, and, in addition to sealing the escape of gas, assisted in giving rotation to the projectile. This at once suggested the idea of getting rid of studs altogether, and a number of muzzle-loading guns were made with numerous and shallow grooves, to which the expanded copper disc or gas check would more readily adapt itself. The guns of the *Inflexible*, at the time of the bombardment referred to, were worked on this principle without studs, and with fairly satisfactory results. It was found, however, that under some circumstances the projectiles were apt to "strip," *i.e.* become detached from the copper band, and leave the gun without any regular rotation. It will readily be seen that the adoption of breechloading guns affords the most easy solution to all these difficulties. Studs are entirely dispensed with, and, it

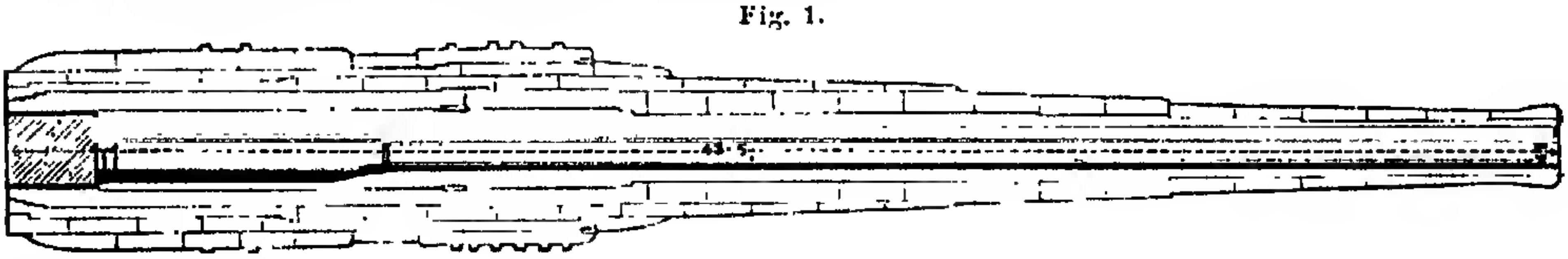
being no longer necessary for the projectile to be smaller than the bore, the bands of softer metal as gas checks and for giving rotation can be fixed on or around the shot in whatever manner may be deemed most fitting and secure.

The rifling of guns was only the commencement of a series of changes which gradually led up to the present size and efficiency of our ordnance. Having obtained greater accuracy, the next step was towards velocity, for clearly the swifter the projectile the more destructive will be the effect of its impact; the slower the projectile, the more must the gun be elevated when being fired, and the shot then describes a curve greater or less in proportion to the elevation before reaching its destination, with the evidently numerous chances of overshooting its mark. If, therefore, a gun can give to its projectile such an increased velocity as will lengthen its effective range by 2000 yards, the gun will then, at any range, be much more likely to strike an adversary.

Accuracy and velocity, however important, were not the only ends which it became necessary for the gunmaker to secure. Concurrently with improvements in guns, vessels of war were armed with iron plates varying in thickness, as time went on, from 4½ inches in the case of the *Warrior*, to 22 and 24 inches around the *Inflexible;* and these massive slabs of iron, against any of which all ordnance up to the time of the Crimean campaign were as powerless as a child's pop-gun, the artillerist was called upon to pierce. Great velocity may easily be attained by firing a comparatively light shot with a heavy charge of powder; but in order to do material damage to an enemy's ironclads or fortifications, there must be an *energy* imparted by the weight of the shot itself. It is a well-ascertained fact, that with properly constructed projectiles, and with the same charge of powder for both, the heavier of two projectiles, while losing slightly in range, gains considerably in penetration, owing to the increased momentum given by its greater weight. The utmost charge in the 100-ton gun would never suffice to send a number of small shot through a 24-inch solid iron plate, whatever the *velocity* with which they might thus be sent, for upon the face of the solid iron small shot would simply be themselves destroyed. The same charge, however, would send the huge 2000-lb. projectile clean through the 24 inches of solid iron.

It was at a very early period seen that to withstand the enormous concussion which, in order to throw projectiles of greatly increased size, guns would now be called upon to bear, bronze was clearly ill adapted; and the first decided advance in the direction which subsequently proved to be the best, was by Captain Rodman, in America. He made his guns of cast iron. But if this material be perfectly homogeneous there is a degree of brittleness about it which could not withstand the explosion of a very heavy charge, however thick the gun may be. Captain Rodman recognized this, and after casting his guns hollow he cooled them down from the interior of the bore, so that the inner portions were first solidified and then compressed and supported by the outer parts as they cooled. Very good guns were made on this principle, but cast iron under any circumstances proved unreliable for the heavier kinds of ordnance, and was displaced immediately Sir William Armstrong brought out his system of building up guns by successive coils of wrought iron over a central steel tube, the coils being welded and shrunk on over each other in such a manner that the steel tube is compressed by the wrought-iron breech-coil holding it; which, in its turn, is compressed by the massive exterior coil, as shown in fig. 1. When the gun is fired, the strain is transmitted at once, or nearly at once, to the breech-coil, and thence more slowly to the outer one. The system is founded upon utilizing to the utmost the strength of materials. There are two forces tending to destroy a gun when fired, one acting in the direction of its length, the other tending to rend it open in the direction of its circumference—the latter, which would have the effect known as bursting the gun, being naturally the most severe. It is necessary to dispose the iron, in this building-up system, in the way best calculated to resist these forces, bearing in mind that both steel and iron are twice as strong in the direction of their fibre as across it. The steel tube was accordingly placed with its fibre running lengthwise, while the wrought-iron coils, after being forged, welded, and then again heated, are shrunk on over each other with their fibre clasping the circumference of the gun. The steel tube was considered to afford sufficient protection against the longitudinal strain, while coil upon coil in the reverse direction gave a powerful security against the more trying transverse force. The various coils or hoops were prepared thoroughly by forging and welding, and then slipped over each other after expansion by heat. Wrought iron on being heated from 62° to 212° expands linearly about one-thousandth part of its length; that is to say, if a ring of iron 1000 inches in circumference were put into a vat of boiling water it would increase to 1001 inches. The co-efficient of expansion, which is constant up to 212°, increases more and more from that point upwards, so that if the iron ring were raised to a temperature 150° higher still (*i.e.* to 362°) its circumference would be more than 1002 inches. Were a coil plunged into molten lead or boiling oil (600° Fahr.) it would be uniformly and sufficiently expanded for all the practical purposes of shrinking; as a matter of fact, however, an improvised fire or ordinary furnace is the more economical mode, and answers the purpose very well, care being taken to avoid such a degree of heat as would cause scales to form. The various coils are hooked together by shoulders to prevent slipping or distortion from the shock of discharge—the expansion by heat enabling the shoulders to pass, while on cooling they grip each other. In the newest of our guns this principle of shrinkage and mutual gripping or locking together is carried out very ingeniously, and in such a way as to add greatly to the longitudinal strength of the gun.

Fig. 1.

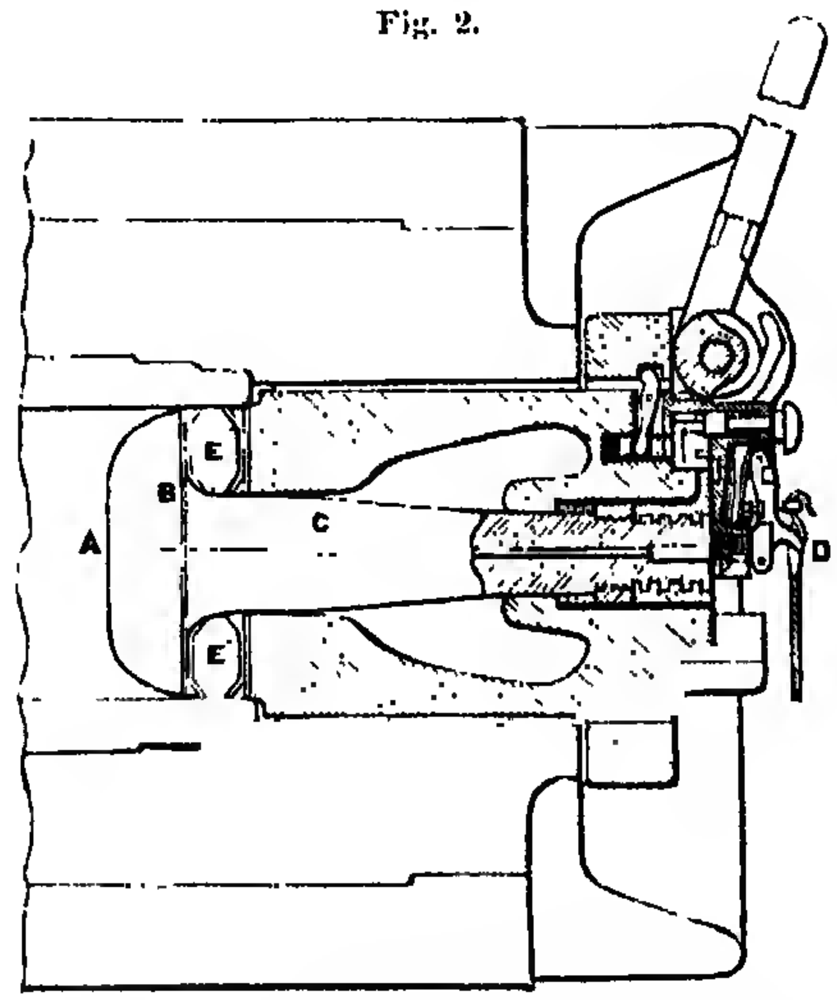


Concurrently with these improvements in the manufacture of heavy guns a better knowledge had been acquired as to the qualities and manufacture of steel. Its superiority over iron in toughness and strength had already been evident, but a scarcity of the proper kind of iron for conversion, and the great costliness of manufacture, restricted its use. The invention of the Bessemer converter, the Siemens-Martin and Gilchrist-Thomas processes, &c., completely revolutionized all previous conditions, and enabled steel to be made at comparatively low cost and of comparatively uniform quality. Sir J. Whitworth was one of the earliest advocates of guns made entirely of steel, but after a series of experiments the steel tube and wrought-

iron coils were at the time preferred as being more reliable, cheaper, and, it was supposed, of equal strength. The German gunmaker, Krupp, adopted solid steel as his material, subsequently modifying his process of manufacture by the use of steel coils; and on this system he turned out guns of 70 tons the power of which was nearly equal to that of the English 81-ton gun. In the face of such practical proof, it needed no very prolonged deliberation to see that wrought iron, like bronze and cast iron, had had its day. Guns of wrought iron might possibly be made to possess the same power as guns of steel, but only by handicapping them with a serious excess of weight, and it was wisely determined that steel should be the material for British ordnance. The other most important change of recent date, viz. the adoption of the system of breechloading, determined upon in 1882, has already been referred to, and the reasons for the change have been pointed out. The coil system of construction has been maintained, forged steel hoops being placed on the central tube and over each other in such a manner as to give the maximum resistance to the main transverse strain, as well as to the longitudinal pressure. The latter is of course a more important item in breechloading than in muzzle-loading guns, on account of the tendency to blowing out of the movable breech-piece or to the injury of the front threads of its screw. To guard against this, the metal of the breech-piece becomes thicker and stronger than at the more forward part over the chamber, while a strong coil, extending to the extreme rear of the gun, clasps the breech-piece tightly over its mechanism, and prevents any tendency to open.

In some respects England had, prior to 1882, fallen behind in the artillery race. Up to 1875 or 1876 our artillery was as good as any, and far beyond that of many powers, but in the adoption of steel ordnance on the breechloading system other nations from that time pushed ahead. One point we have in our favour. In a science which advances so fast as gunmaking has been doing of late years, the power which waits longest before committing itself to a new manufacture has the best of it, always supposing that it is not caught napping by an important war. The improvements in the chambering of guns and lengthening of the bore are of a character so vitally important that the short steel breechloaders of the Continent, as they existed in 1882, were as utterly obsolete as the short wrought-iron muzzle-loaders of England; and in our re-arming with steel breechloaders we were able to select the best points from the various systems worked out by others. This experience was particularly valuable to us as regards the breech-piece arrangement, the most complicated and difficult matter in a breechloading system. A comparatively simple and very efficient action has been adopted, founded on a plan already thoroughly tested in French guns. The bore is continued right through the rear extremity of the piece, the breech end forming an intermittent screw, that is, a screw having the threads intermittently left and slotted away. The breech-block has a similarly cut screw on it, so that when the slots on the block correspond with the untouched threads in the gun, the block can be pushed straight in, and the threads made to engage by part of a revolution. The breech-block being thus thoroughly secured, it then becomes necessary to provide against any escape of gas, which obviously exerts a force upon the breech equal to that upon the shot. This is effected by an arrangement by which a stalk, C, fig. 2, passes through the breech-block, its foot being secured on the exterior. The stalk has a mushroom-shaped head, B, projecting into the bore. Round the neck of the stalk, just under the mushroom, is a collar or pad of asbestos, E E, secured in a canvas cover. When the gun is fired the gas presses the mushroom against the asbestos collar, and squeezes it against the walls of the bore. It is found that this effectually cuts off all escape. The firing arrangement consists of a removable needle-holder, which carries a percussion tube nearly to the end of the bore; the needle passes from the tube to the rear of the breech-screw, and is there struck by a hammer, actuated by a lanyard. The vent, A, passes through the mushroom, B, and stalk, C; a clutch box on the rear end of the stalk carries a percussion lock, D. The mechanism appears extremely complicated, but is by no means so much so as it would seem at first sight. Not only is it difficult for the parts to get out of order, but any or all of them can be exchanged in a few minutes; while the safeguards that are provided by this apparent complication of action are numerous and

Fig. 2.



important. The tube, for instance, cannot be struck by the hammer, even though the lanyard be pulled, till the breech is screwed home. Should there be a miss-fire, the slide is drawn back to permit the exchange of the tube, and the new tube cannot be fired till the slide is pushed properly over the tube again. Should the thumb slip in cocking, the hammer will not fall on the striker so as to explode the tube, but on a projection which is removed when the lanyard is pulled. The firing of the gun is by these various arrangements rendered impossible until the breech-piece is properly fixed; and it is to be observed also that the whole of the mechanism is at the rear, and thus protected by the gun itself - unlike the Krupp arrangement, which protrudes from the side, with a dangerous degree of exposure.

All the several portions of the breech-piece are of the finest gun steel, saving of course the obturator, that is, the pad or collar of asbestos behind the mushroom head. Some arrangement of this kind is necessary in all breechloading guns, to stop any escape of gas; for however impossible such escape may seem when the breech-block is screwed tight home, the enormous pressure on firing would otherwise soon produce most dangerously erosive rushes of gas by the breech. Copper rings are used for the same purpose in some other systems, but the asbestos obturator invented by M. de Bange is believed to be the best.

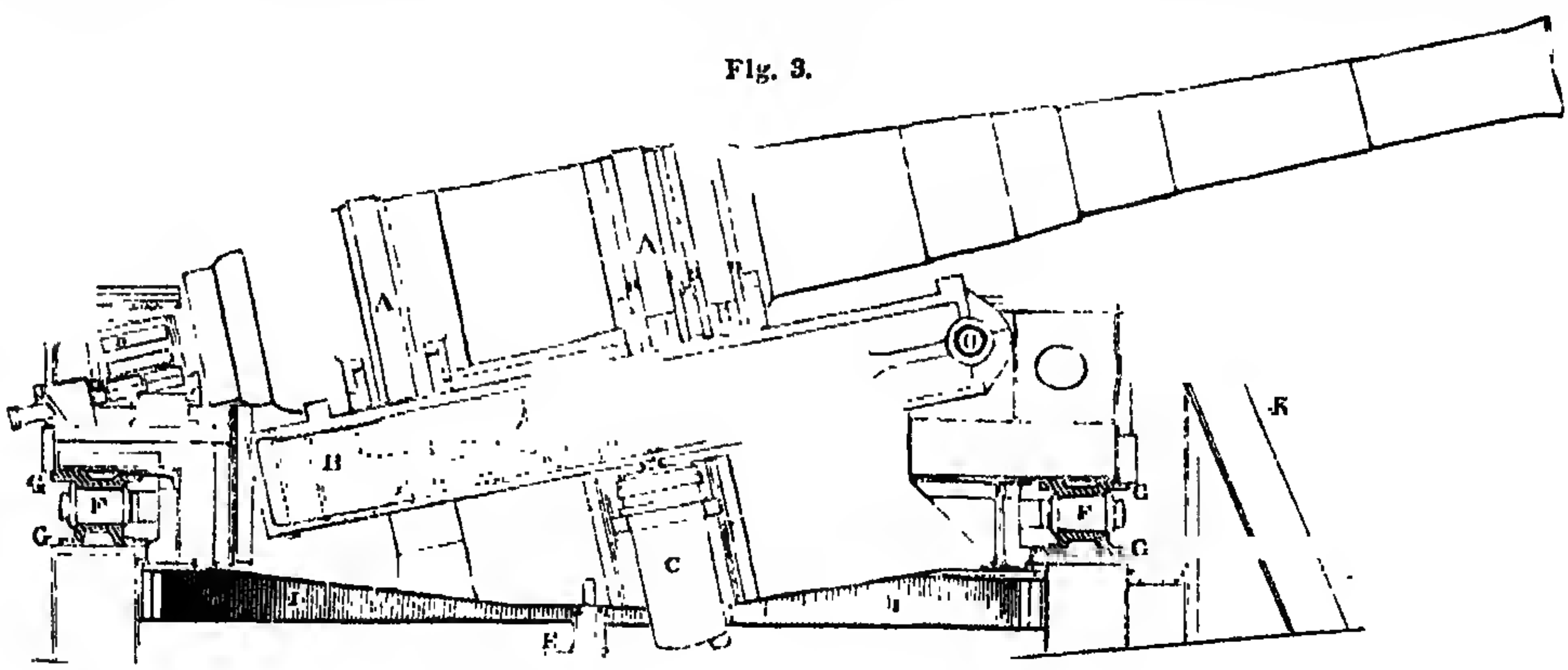
No less than fifteen months are required for turning out a heavy gun of the new steel breechloading type, but sufficient plant was erected for the manufacture of several to proceed at once; and the vigour with which our re-armament proceeds may be imagined from the fact that by the end of 1884 the government possessed about 500 of the new pieces, varying from 2 to 110 tons. Private firms supply a portion of these, the others are

the work of the Royal Gun Factory, Woolwich, under the superintendence of Lieutenant-Colonel Maitland, the steel in the latter case being supplied under contract by Sir J. Whitworth.

There is another class of construction known as "wire guns," which may possibly come into increasing prominence, but which in 1884 could hardly be considered to have got much beyond the experimental stage. In the case of these guns, instead of being reinforced with steel coils or hoops, the breech-piece receives great transverse support from a flat steel wire or ribbon, which is wound round it like thread on a reel, but at considerable tension. Thin protecting hoops of steel cover the wire and form the exterior of the gun. The plan is one which gives lightness to the piece, but there is a want of longitudinal strength, and it is doubtful whether by steel guns we have not reached the safe limit in reduction of weight, inasmuch as the lighter the gun in proportion to its power, the more work is thrown on the carriage in checking and absorbing the recoil. Should experience prove this to be the case, there will be little advantage in the introduction of wire, except in certain special cases, such as siege howitzers, &c.

The manipulation of breechloading guns is found not to be attended with any more difficulty than that of muzzle-loaders. The usual complement of men to an ordinary gun is sufficient, while as for the heavier ordnance mounted in fortresses or in ships' turrets, the hydraulic apparatus invented by Mr. Rendel is such as to enable a 100-ton gun to be easily worked even by one man. The manner of mounting and working the huge piece on board one of our ironclads of recent construction is as follows:—The usual trunnions are entirely absent. The gun lies embedded on a sort of sledge carriage, which is a mass of steel weighing about 14 tons. Projecting rings, which form part of the gun, rest in grooves, and prevent any backward or forward motion of the piece on the carriage, and rotatory motion is prevented by strong steel straps, A A, fig. 3. Thus the gun and carriage are securely bound together, having their axes parallel, and recoil together in the same direction. The carriage rests and slides upon the planed surface of two cast-steel beams of about 10 tons weight each. They are held together by the recoil cylinder, B, and their front ends pivot vertically on a massive hinge, H. Thus the axes of the gun, the carriage, the recoil press, and the slide are all parallel, whatever the elevation, and the difficulty of restraining the rotatory motion caused in other systems by recoil is completely got rid of. Lateral motion is upon rollers, F F, along roller paths, G G. The whole weight is taken by two powerful hydraulic presses, C, which work always together, being acted upon by one common supply pipe. If the muzzle of the gun is to be elevated, the hydraulic rams sink, and the slide, pivoting on its

Fig. 3.



front end, is lowered in rear, carrying with it recoil press, gun, and carriage. The reverse takes place when the gun is to be depressed. Not only is there the advantage of harmonious recoil, but the pivoting on the end of the slide enables the gun to be fired through a very small port, which it fills almost completely. This is an improvement on the *Inflexible*, where it was found necessary to attach to the muzzle of the gun a steel shield, formed of 2-inch bars, to guard the port from the fire of rifles and machine guns. Fig. 3 shows such a gun mounted *en barbette*, E being the central pivot on which it turns, I I the rack, and K an armour plate.

The loading arrangements are also extremely simple, and present some features of novelty, besides the mere fact that the gun is loaded at the breech. With the exception of bringing up the ammunition and ramming, which are performed by another hydraulic apparatus, the whole business of opening and closing the breech is performed by two levers close together, which are worked by one man. He cannot make a mistake, for nothing can be moved out of its proper order, and whatever position a lever may be in at the end of its last movement, the next act is performed merely by pushing or pulling the lever to the opposite side. One pair of levers works the whole breech-closing apparatus, prepares the gun for loading, or opens the breech after discharge. Another pair of levers runs the gun out and in, and elevates or depresses it. It is impossible to run it back or forward too far, and the whole mighty mass of metal may be managed by the hand of a lady, who cannot possibly make a mistake. If she touches a lever it must be to pull it back or thrust it forward from the position in which it then lies, and no movement that can be made will set anything wrong. All the movements involved in opening the breech, withdrawing the breech-screw, replacing and closing the breech, can be performed in less than one minute, with almost absolute safety even in the heat of action; and the gun cannot be fired till the operation of loading and closing the breech has been completely performed.

Behind and across the breech of the gun, but entirely separate from it, is a slide-bed similar to that of a lathe, and on this bed moves a saddle which carries the loading-tube and a rest for the breech-screw when drawn out of the gun. Now, let us suppose that the gun has been fired and requires to be loaded. By touching the levers for elevating and running back, the gun is brought into the loading position exactly. A touch on another lever brings the saddle into its proper position, unlocking and turning the breech-piece as it comes. A touch on the third lever brings up a piston from the rear, and makes it engage a

catch in the breech-piece. The same lever moved in the opposite direction draws out the breech-piece, D, upon a bed made to receive it on the saddle, which is then drawn out of the way by a reverse movement of the lever which brought it up. As the saddle moves sideways, that part of it containing the loading tube comes into position exactly behind the rear end of the bore. The small piston which withdrew the breech-piece now pushes the loading tube into the gun, the object of the tube being to protect the threads of the female breech-screw from abrasion by the shot. All is now ready for loading, which is performed much in the same manner as in the muzzle-loading 100-ton gun. The projectile and its two half-charges are always kept ready on trolleys, which rise by hydraulic pressure from their places in the magazines, and arrive between the hydraulic rammer head and the breech of the gun. Other levers thrust them forward into their places; the loading tube is withdrawn and the breech closed by a reversal of the different movements just described, which do their work more quickly than the description of their action can be read. The breech of the gun cannot be moved till all is complete, and the piece cannot be fired unless the breech is accurately closed and locked to prevent its opening by concussion of discharge.

The dimensions of this 100-ton gun are as follows:—length, 40 feet; diameter at muzzle, 2 feet 9 inches; diameter at breech, 5 feet 6 inches; diameter of bore, 17 inches; diameter of powder-chamber, 19½ inches. Fired for testing against armour plates, the charge consisted of 772 lbs. of powder, which gave to its 2002-lb. shot a velocity of 1841 feet per second, and the enormous energy of 47,036 foot-tons. The gun was tested at Spezzia in 1882, and may be said to mark the huge strides of the gunmaker's art in the twenty-six years from 1856, when the greatest wonder in guns was the 68-pounder, with its 16 lbs. of powder and a 66-lb. shot.

If it be asked why such monstrous pieces of ordnance should be used at all, the reply is that the condition of the contest between guns and armour-plates has been completely changed by the construction of steel and compound armour. A gun which could send its projectile clean through 24 inches of solid iron, failed to get through an 11-inch plate faced with 3 inches of steel. Steel plates can be made impenetrable even to the energy of 47,000 foot-tons, though it is unlikely that any vessel could stand the force of two such blows well directed; the plates would probably be smashed and the desired damage effected. But the projectile has yet to be found which could perforate some of our steel-clad vessels. Chilled iron-shot, which had done wonders with iron plates, splash harmlessly on the surface; while steel shot usually break if too hard, or flatten out if too soft.

We have dealt hitherto with such heavy guns as are carried by our navy and in fortresses; and with an insular nation of a peaceful disposition it is perhaps natural to attach the first importance to these defensive classes of ordnance. It is to be remembered, however, that wars which turn on the comparative power of heavy naval ordnance are few and far between, while every engagement which takes place in the smallest campaign depends to a greater or less extent on the character of the rival field artilleries. In none of our "little wars" against weak nations and undisciplined troops has success or failure ever hinged upon ironclads and big guns, but always on shore forces with their rifles and field artillery. It would be in the highest degree dangerous to neglect naval ordnance, the importance of which may be declared suddenly at any time; but in view of the important part played by artillery in all great wars of recent date, it would be equally culpable to be content with a secondary place as regards light field pieces.

The manufacture of field artillery differs in several considerations from that of heavy ordnance. A heavy gun may be designed with the one object of shooting well and destructively. The carriage can then be designed to match the gun, and the platforms, whether in ships or forts, built to match the gun and carriage. But in the case of field artillery there are bounds of weight, recoil, and carriage of ammunition which cannot be broken; and the designers are limited by tactical considerations. The first of these is the absolute necessity of energy and rapidity in the use of field artillery. Both gun and carriage may be of magnificent construction, but if deficient in mobility it is utterly useless for modern warfare. There are two regular field guns in the British service, the 16-pounder of 12 cwts. and the 9-pounder of 8 cwts., both wrought iron and steel muzzle-loaders. These were introduced in 1872, and at that time were far the most effective and deadly field guns in existence. The French guns were then far behind, especially in ammunition; the German were rather lighter, but less powerful, with inferior velocity, no greater accuracy, and without shrapnell, in addition to which the great war of 1870–71 had developed serious defects in their breech-closing system. The Austrians were still further behind in all respects; the Russians and Italians hardly worth speaking about. Immediately after the war, however, the Germans set to work to reconstruct their field artillery, and produced the patterns of guns which still exist in their service. Krupp improved his breech-closing fittings, and produced steel guns which were an enormous advance upon the weapons employed against the French, and surpassed also the English muzzle-loaders in all the qualities of a good field artillery. Krupp's lighter gun weighs 7 cwts. and throws a shell of 11 lbs. weight, with a muzzle velocity of 1525 feet per second; the heavier weighs 9 cwt., and throws its 17-lb. shell with a muzzle velocity of 1460 feet per second. These are known as the pattern of 1873, and are formidable weapons against those of any nation. Austria commenced her experiments about the same time as Germany, and followed pretty closely the German pattern. But she was in no hurry to re-arm. Using the metal of her old bronze guns, but treating it in a new way, according to the inventions of Colonel Uchatius, she produced in 1875 her present pattern, and, profiting by the experience of the Germans as well as her own, made certain steps in advance. Her steel-bronze field artillery—which has, showever, no steel in it—is therefore slightly superior to that of the Germans. The French were even slower in their re-armament. A large number of different patterns were sent in and tried, all superior to their muzzle-loaders of the old time, and even to the Reffye breechloaders made during the war. But of these latter a great number had been made, sufficient for any small war, and France did not pretend to undertake great campaigns. Her artillerists worked slowly but surely through a mass of experiments which resulted in the final choice of steel breechloaders, rather better than either German or Austrian. The Italians followed the Austrians slowly, but subsequently added to the power of their guns by alterations in ammunition. One of their guns is of bronze, the other of steel. The Russians remained far behind till towards the close of their war with Turkey, after which they gradually provided themselves with steel breechloaders very much like those of the Germans, but with the peculiarity that they have three different pieces, one called the light gun, the second the horse artillery gun, and the third the battery gun. Both as regards the number and efficiency of field artillery guns every important nation was in 1884 superior to the English; but the remarks we have already made as to the advantages possessed by the nation which re-arms last apply equally to field artillery. Experiments which have been in progress since 1879 have resulted in ample material for rapidly transforming our field guns, and obtaining a position even superior to that occupied in

1872, if only the means are voted with unstinted hand. In all probability steel, which has received such marvellous development since 1872, will be the material of our future field pieces, if not of the carriages also; while a breech-loading system seems indicated by the same paramount necessity as we have seen compelled its adoption for naval ordnance.

Machine Guns.—The history of small-bore machine guns may be considered to date as far back as the invention of cannon, for shortly after that event, and before field pieces were constructed, a species of small-bore machine gun (termed ribaudequins, or organ guns) was employed as the only weapon available for field artillery purposes.

In the sixteenth century the difficulties of constructing carriages adaptable to the use of field guns having been to some extent overcome, organ or machine guns gradually fell into disuse. They reappeared during the American Civil War of 1860–63, when, at the siege of Charleston, a so-called "rifle-battery," the Reyner, was used. Its weight was 1400 lbs., and it discharged 175 shots per minute. But little attention was attracted to it. Some Gatlings were also with the Northern army. The Montigny rifle-calibre gun, better known as the "mitrailleuse," was used by the French in the Franco-Prussian War of 1870. It fired from 150 to 200 shots a minute, contained from twenty-five to thirty-seven barrels, and its mechanism was heavy and complicated. Its introduction had been kept so profound a secret that the gunners did not understand the working of the machine, and the officers were ignorant as to its tactical employment. Still it produced great effect, and its mysterious grunt came to be regarded with unpleasant feelings, even by the hardiest and best-seasoned of the German troops. As, however, it did not answer the expectations formed of it, the Germans and French practically discarded it for field operations, and the British government was much influenced by their example. Since then great improvements have been made by several inventors, and the weapon has during the last few years crept into favour, especially with the Russians. In our own army so eminent an authority as Lord Wolseley recently predicted "an enormous future for it." In military circles generally, however, machine guns encountered no small prejudice, under the mistaken idea of their being designed to supplant artillery.

A decided advance upon the French mitrailleuse, and the first machine gun ever adopted by the British authorities, is the invention of Dr. Gatling of the United States. Its principle is that of the revolving machine gun, and it consists of a certain number of rifled steel barrels revolving round a central shaft as a common axis; for each barrel there is a separate lock, and they are caused to rotate and motion is imparted to the loading and firing mechanism by a hand crank. The weight of a Gatling gun varies according to its calibre and the number of its barrels—the weight of the English service gun, with ten barrels, being $3\frac{3}{4}$ cwts. Its rapidity for ten barrels is 400 shots per minute, and the latest improved pattern of Gatling gun has fired up to 660 shots in one minute. There is no independent action of each barrel, nor can volleys be fired, but only single shots.

Whether, however, machine guns were to be used on land or not, there seemed little doubt as to their utility for naval purposes. Most of the numerous improvements of the weapon were, in fact, produced as a species of response to the torpedo. Huge ironclads, each costing about £750,000, and carrying the heaviest ordnance, found themselves, nevertheless, in the undignified position of being unable to cope with the swarm of insignificant-looking craft which buzzed around them and threatened to blow them up. Some special means were evidently necessary to keep these dangerous small fry at a safe distance, and the Hotchkiss or Nordenfelt machine guns answer this purpose more effectively, if well served, than the kind of crinoline-network which it was proposed to fit up around armour-plated ships.

Mr. Nordenfelt is the inventor of a series of guns with mechanical appliances for insuring rapidity of fire, varying from those of the same calibre as ordinary rifles, and firing the same ammunition, to guns of $2\frac{1}{2}$-inch calibre, firing 6-lb. shells capable of piercing 3 inches of armour. The rifle-calibre gun of five barrels fires 600 shots per minute, as compared with 300 to 400 by the Gatling ten-barrel, or 160 by the old French mitrailleuse. If the Nordenfelt ten-barrel gun be used, a stream of no less than 1000 shots per minute may be pumped upon a luckless enemy, and there are circumstances quite conceivable under which three or four such guns, served in all by less than twenty men, might hold a whole army in check. The extreme range of such a gun is the same as that of the Martini-Henry rifle—about 3000 yards—though the accurate or generally useful range would not exceed from 1200 to 1500 yards. The recoil of the weapons is effectually checked, so that they need no further aiming, even after volley firing; while the mechanism provides for a lateral or scattering fire. Extraordinary, however, as are the performances of these guns, the Gardner inventions, described further on, have been preferred for use in our army, and their wonderful efficiency, as proved by actual use in the Soudan, appears to have fully justified the choice.

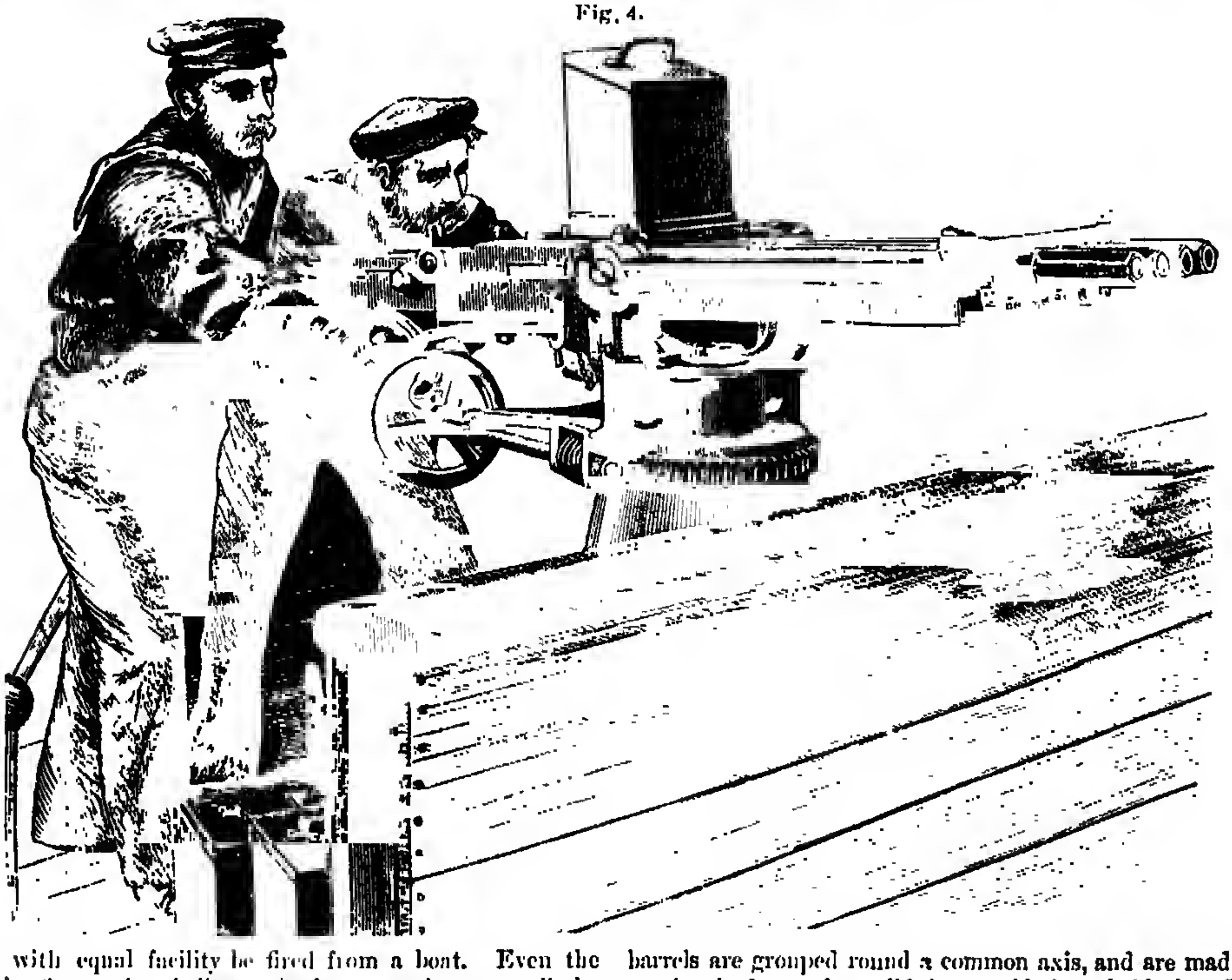
The Nordenfelt gun, chiefly relied upon in the British navy as an "anti-torpedo-boat machine gun," is one of four barrels, each 1-inch calibre, firing armour-piercing, solid, elongated shot. It is a very powerful weapon, capable of pouring a rain of destructive bullets at the rate of 150 to 200 per minute, such as would pierce the armour and boiler-plates of a torpedo boat, and thus destroy and probably sink it, long before the latter could get near enough to discharge its deadly freight. This anti-torpedo-boat gun, of which we give an engraving (fig. 4), was the first of the Nordenfelt series introduced into the British navy, and consists of a rectangular framework of wrought-iron, the sides of which are connected by three plates or transoms. The four barrels are placed side by side in the frame, their muzzle-ends passing through the front cross-piece, while the breech-ends are screwed into the middle cross-piece. The principal parts of the gun are—the *hand lever*, which is fixed to the axis pin, and sets the whole mechanism in motion; *action block*, placed in rear of the middle cross-piece, and capable only of movement backwards and forwards. In front of this part are screwed four steel breech plugs or plungers, corresponding to the barrels. Each is pierced with a channel, in which a firing pin moves freely, and furnished on the right sid with a claw extractor. Behind each firing pin is a hammer with a projecting tenon, and behind each hammer is a strong spiral spring. A plate pivoting on an axis, and with two curved slits therein, gives reciprocating motion to the locking or recoil bolts. The director plate or cam is secured to the action block, and in its slots fits a roller working on a stand on the action lever. In the rear there is a bar, kept in its place by a thumbscrew, and which retains the four firing springs in the action block. The *carrier block*, or cartridge receiver, is a cast-iron plate having four longitudinal holes for the empty cartridge cases to drop through when extracted, and a similar number of strips on which to carry the cartridges when loading. This block is capable of slight lateral motion, which is afforded by a lever pivoting freely on the motive axis. The *trigger comb* is secured to the rear cross-piece, and is capable of lateral movement: it has four teeth, and is pressed to the left side of the frame by a powerful spring fastened to the rear cross-piece. The *action lever* is fixed to the motive axis, and has a stud on which the director-friction roller works; also in front a tongue to work the recoil bolt-plate, and in rear a tongue to move

the trigger comb to the right. The *breech cover* has on its top a slide stop and catch for the hopper, and also four holes, through which the cartridges pass from the hopper to the carrier block. It is pivoted to the frame in the rear, and kept in position by means of a spring lock.

When mounted on board the gun pivots upon the apex of a conical stand, formed of wrought-iron plates, and of a convenient height for manipulation. It is worked by three men, one of whom watches the delivery of the cartridges into the feeding trough, while the second works a lever backwards and forwards, firing all four barrels in momentary succession at every movement, and the third points the gun upon the object attacked, and changes its direction at will. Like most machine guns it is provided with racking gear, by which a sweeping movement is automatically imparted by the firing lever. The heavier Nordenfelt guns of 1·85-inch and 2·2-inch calibre throw 3-lb. and 6-lb. shells, capable at 1000 yards of piercing 1·2 inch and 2·5 inches of steel respectively. There is a recoil of 3 inches in the case of the heaviest gun, the 6-pounder; but even allowing for the re-aiming which then becomes necessary, twelve shells per minute may be fired. Such guns find a useful place in unarmoured cruisers, troopships, gunboats, &c., and both on land and sea in the numerous cases that arise when the firing of heavy ordnance involves not only delay, but waste of power.

A feature in which machine guns claim to excel is the extremely valuable and often vital one of *mobility;* and there seems no doubt, from the result of crucial tests, that they combine lightness with their other extraordinary qualities in a very eminent degree. A one-barrel rifle-calibre gun, firing 150 to 180 shots per minute, can be carried by a light cavalry soldier without overburdening his horse. Two foot soldiers can easily carry one of three or five barrels, with tripod stand, and a liberal quantity of ammunition. One of the ten-barrel guns may readily be moved about on a light carriage drawn by a couple of men; or either the five-barrel or the ten-barrel may be fixed on the ship's rail or mounted in the top. The anti-torpedo-boat gun may also be put up aloft, or it

Fig. 4.



may with equal facility be fired from a boat. Even the heavier 6-pounder shell gun, in fact, may just as easily be fixed in a boat as on an ironclad. And such facility of moving rapid-firing guns is an important item in their efficiency, especially when being carried about in the uncivilized and mountainous countries in which some of the "little wars" of this country have been carried on. Be that as it may, there can be no doubt of the value of well-handled, quick-firing machine guns at the defence of a work, defile, bridge-head, road, &c., when the time afforded the defence to stop the rush of an assaulting party and to beat it back can only be counted by minutes and seconds, during which short period the fire of the defenders should be unbroken and overwhelming.

The Hotchkiss gun first found favour abroad, especially in the French navy. In its general form it consists of five barrels, made of Whitworth fluid-compressed steel. These barrels are grouped round a common axis, and are made to revolve in front of a solid immovable breech-block. This breech-block has an opening in the upper part to introduce the cartridges, and an opening underneath for the exit of the empty cartridge cases, which are thrown out by means of an automatic extractor. The cartridges are fired singly as they present themselves by the rotation of the barrels to the blow of the firing pin, and while resting for an instant motionless in front of the solid portion of the breech. The turning of a crank causes the automatic loading, firing, and extraction of the empty cartridge cases. In the working of the gun the gunner is enabled to point the weapon in any direction by bearing against a shoulder-piece possessing a practical resemblance to the butt-end of a rifle, but different in form. Pressing against this lever, as it may be termed, the gunner is able to raise or depress the muzzle of the gun, and to turn it to the right or left.

His left hand also grasps a directing-handle under the breech of the gun, while his right hand turns the crank. The gun is attached by its trunnions to a pivot working in a socket, the effect being to afford facility of motion both in a vertical and a horizontal plane. The type of gun most extensively adopted has a calibre of 1½ inch, firing an explosive shell weighing 1 lb., or a steel shot nearly one-third heavier. These will penetrate steel armour of 1 inch in thickness at ranges of about 2000 yards when striking fair, or at 600 yards when at an oblique angle, up to 70 degrees. The maximum rapidity of fire is nearly eighty rounds per minute; or when accurate shooting is required, from thirty to thirty-five rounds per minute. There is a larger specimen of Hotchkiss gun, the calibre of which is a little less than 2 inches, and the projectile either a steel shot or shell weighing nearly 2½ lbs. These are capable of piercing steel plates 1½ inch thick at a distance of nearly a mile, the rate of fire being twenty carefully-aimed shots per minute, or sixty at close quarters. The gun is, in fact, a small rapidly-firing cannon. A still larger one has been constructed, having a calibre 2¼ inches, and firing thirty rounds per minute, the weight of the shell being about 5½ lbs. The generality of the Hotchkiss guns, in fact, are of a heavier type than the Nordenfelt; and while excellent for their purpose as shell guns, are necessarily of a somewhat less portable character than the Nordenfelt. In the United States the Hotchkiss guns are used extensively as field pieces.

The Nordenfelt is, as already observed, extensively adopted in the British navy, and it is claimed for these guns that they are as serviceable for rifle-calibre as for shell fire; but a select committee on machine guns reported in 1881 in favour of the Gardner system for rifle-calibre guns. Large quantities of two-barrel and five-barrel guns on the Gardner system were consequently purchased by the government, and their efficiency and value were clearly proved in the Soudan at the battles of El Teb and Tamasi, where they did great execution. They also possess the very essential qualities of lightness, simplicity, and portability.

The working of the gun is as follows:—The bullet ends of the cartridges are inserted in a perforated wooden block, and are thus conveyed to the "reservoir" of the gun. This reservoir has a flanged way or a T groove, which holds the cartridges by the head or rim, and the cartridges fall by gravity to their places at the rear end of the barrels, as shown in fig. 5. The turning of the handle, or hand crank, actuates the simple mechanism, and the "plungers" push the cartridges into the barrels, where they are discharged, while the continued rotation of the crank extracts the empty shell of cartridge. In the one- and two-barrel gun the empty shells are expelled through orifices at the side of the gun, and in the five-barrel gun they are withdrawn from the rear end of the barrels, and are forced through apertures in the cartridge rest, and fall to the ground nearly vertically. The speed in the rotation of the hand crank necessarily gives the rapidity of fire. The one-barrel gun has been fired at the rate of 300 shots per minute, the two-barrel at 600, and the five-barrel at 1200. The cartridges fall by gravity, but gravity is always accelerated by the firing of the gun and by the insertion of new cartridges. The speed of firing, it will be noticed, is double that of the Nordenfelt gun, while the portability is fully equal.

Remarkable, however, as are the performances of these various machine guns, they are eclipsed by the invention of an American gentleman, Mr. Hiram S. Maxim. All the machine guns hitherto described are worked by the continuous turning of a handle, the operator having also to give lateral motion, while another man feeds with ammunition. Mr. Maxim's is a truly automatic machine gun, for on simply pulling a trigger once it will feed itself and fire away continuously at the rate of 600 rounds per minute if desired, the operator only having to impart the traversing motion as required. The gun has a single barrel, and is arranged in such a way that the force of the recoil from one round is utilized and forms the motive power for loading and firing the next round, and so on round after round in succession. The weapon is of the ordinary rifle calibre of ·450 inch, and weighs, with its tripod stand, 126 lbs. It stands about 3 feet high, and is about 4 feet 9 inches long from muzzle to rear of firing mechanism. The cartridges, to the number of 333, are placed in a canvas belt, some 7 yards long, and length can be attached to length as each becomes emptied, so that firing may be kept up continuously. The belt is placed in a box immediately below the gun, and the leading end of it is inserted in the gun to start with. As the gun is fired the belt is drawn into it on one side, and one after another the cartridges are drawn out of the belt, forced into the barrel, fired, and

Fig. 5.

the empty belt and cartridge cases ejected from the opposite side of the gun. The rate of firing is regulated by the distance of pulling over a lever on a quadrant scale, and may vary from one to 600 rounds per minute. Once adjusted for a certain speed, the firing is maintained at that rate until the supply of cartridges is exhausted, independently of human agency; so that were the gunner killed, his machine would still work on. Mr. Maxim has an ingenious arrangement for applying the belt system of automatic firing to rifles fired from the shoulder; but the system above described appears to be the most practicable, and delivering, as it does, a perfect hail of bullets, and being self-acting, it would appear to commend itself for use wherever machine guns are applicable in war. The weapon was brought out towards the close of 1884, and at that time had had no experience in actual warfare. The exposure of gunners is reduced to a minimum, there is a device for obviating the effects of overheating by rapid firing, and an arrangement for carrying the smoke off from the muzzle.

GUN COTTON, or *Pyroxilin* or *Trinitro-cellulose.* In the year 1846 Professor Schönbein of Basel announced that he had discovered a substance possessing all the useful qualities of gunpowder without its defects, and exhibited it at the meeting of the British Association at Southampton in that year. The invention made its way into popularity with great rapidity, for what could be more agreeable than an explosive material of great strength, in the form of a beautiful, soft, clean substance, that gave no smoke in its combustion and left no traces behind? In fact a general enthusiasm arose; and while Messrs. Hall of Faversham began to manufacture it in England, foreign governments seized upon the idea and began to carry it vigorously forward. But if its popularity arose and spread rapidly so did the reaction against it. Terrible explosions occurred in factories and magazines—not in one country, but in all—and for a time manufacturers would have nothing more to do with so deadly a material. After a lapse of some years, during which little was heard of the matter, Baron von Lenk, a captain of artillery in the Austrian army, instituted a series of experiments and ascertained how to render gun cotton safer, and also to regulate its action to a certain extent; for one of the great faults of that first made had been its excessive rapidity of ignition, and consequently destructive effect upon the gun in which it was fired. The method employed was to spin the cotton into thread, and roll this on a small reel for rifle cartridges, and to coil this again into ropes for large artillery and mining. The amount of success, however, was not sufficient to justify its adoption for artillery purposes; but it was very extensively used as a mining agent, for which it was found in every respect admirably adapted. In 1862 the British Association again took up the matter, under the advice of General Sabine, R.A., president of the Royal Society. In the following year the English government appointed a committee to investigate the whole subject, and Mr. Abel, F.R.S., chemist to the war department, effected numerous improvements in the process of manufacture, which is in brief as follows:—Rough waste cotton, no matter how short the fibre, is cleaned thoroughly, dried, and dipped into a mixture of three parts sulphuric acid to one of nitric. If the acids were weak the cotton would dissolve. With the strong acids used a combination of the nitric acid and cotton ensues, while the sulphuric acid takes up the water left behind by the nitric acid, and so keeps the latter always strong. There is a row of small tanks fed with acid through pipes from a reservoir. Into each of the tanks a pound of cotton is dipped, care being taken to immerse it all completely. It is then taken out and laid upon a grating over the tank to drain, and thoroughly squeezed by iron paddles. Twenty minutes suffice for this operation. The converted cotton now goes into jars, which stand in water to keep them cool, for much heat is developed in the combination. After soaking here for many hours the cotton is placed in a revolving drum with small holes in its exterior. It whirls rapidly round, and discharges most of the spare acid by its centrifugal force. Then comes a very important process—the washing. First the cotton is thrown into a fall of water, and a man watches to prevent any of it escaping instantaneous immersion, otherwise the acid and the water would set up an action strong enough to burn some of the cotton, or at least damage it. After thorough washing in a tank under the waterfall the material is placed in a vat to steep in water until no acid is perceptible. The cotton is then placed in a mill like that used in paper-making. The water used to make the pulp is slightly alkaline, in order to take up the last traces of acid. The next operation is drying again in a centrifugal machine. There has now been produced a gun-cotton pulp, which has only to be pressed into the shapes most convenient for its intended purpose. The most common forms are those intended for fowling-pieces and blasting. It is found that whereas gun cotton fired by simple ignition puffs off harmlessly, exerting no destructive force whatever upon the body on which it may be resting, the same quantity of gun cotton exploded by concussion has a power equal to more than six times its weight of gunpowder, and will shatter blocks of granite, break up thick iron plates, and blow down or destroy any body in contact with it. When it is added that this substance is perfectly safe to store, transport, and handle; that its combustion when fired in this way is so complete that no noxious gases are given forth; and that the primers, or detonating substances, are quite as harmless as ordinary percussion caps for fowling-pieces—it will be seen that mining of all descriptions, military and civil, becomes immensely facilitated, while the dangerous operation of "tamping" is rendered unnecessary. For torpedo and submarine purposes the discovery is also especially useful.

The absolute harmlessness of the material when made under Mr. Abel's processes was supposed to be conclusively demonstrated when a gun-cotton magazine at Penryn was burned down in 1869, and the 40,000 charges which it contained quietly burned away without any explosion whatever. In August, 1871, however, grave mistrust of its safety was again excited when the large gun-cotton works at Stowmarket, in Suffolk, were suddenly destroyed by a disastrous and fatal explosion; but the result of a most searching inquiry was to show that the explosion was due to the spontaneous combustion, under the accelerating influence of very hot weather, of some impure gun cotton, the impurity consisting in the presence of a quantity of sulphuric acid maliciously added after the cotton had passed through the regular process of manufacturing and testing.

In 1872 the government appointed a special committee to investigate the subject of gun cotton, and a series of valuable inquiries and experiments were carried out, the result being ultimately embodied in a report issued in 1875. It was clearly shown by the researches of this committee that gun cotton, when its manufacture has been conducted with due precaution, is one of our safest as well as most powerful explosive agents; that its use as a military explosive is far safer than any nitro-glycerine compounds, because it is not liable to explosion from concussion or the impact of bullets; and that, as regards transport, it may be conveyed by water or railway with the most absolute safety. The condition of such safety is that the gun cotton be moistened by the addition of about 25 per cent. of water. This would not detract from its explosive power, while it could not in that state be ignited, much less exploded, either by a spark, by heat, by friction, or by a collision, even if it resulted in the extreme case of the contents of a locomotive fire-box being emptied upon a truck full of gun cotton—in fact, if exploded surreptitiously, it must be the act of a skilled malefactor, provided with the necessary appliances, and thoroughly acquainted with the *modus operandi.* Such conditions of safety cannot be claimed for gunpowder, which a spark would explode; and much less for nitro-glycerine compounds, to which the oscillation of a conveyance constitutes a source of danger.

The committee found that a thoroughly wet disc of compressed gun cotton is perfectly uninflammable when exposed to the action of ordinary heat. For example, it would be impossible to set light to a wet disc of gun cotton with a red-hot poker. If, however, moisture be present only in a moderate degree—that is, if the disc be only slightly damp—the gun cotton when touched by the poker would smoulder something like touch-paper. If the disc be thoroughly dry the application of the poker would set it alight, and it would burn fiercely until consumed; but by a different application of heat—namely, by firing with a detonator—the dry disc may be made to exercise a violently destructive action. It was also found, by experiments

carried out in 1873, that damp or even thoroughly wet gun cotton can be exploded with as much facility as dry gun cotton. It is only necessary that the small part of the charge in immediate contact with the detonator should be dry.

It is not, therefore, now necessary to dry the current supply of gun cotton before use; the damp or wet material may be taken straight from the store to the mine or torpedo. With ordinary precautions, too, there would appear to be no danger arising from the storage of gun cotton in its wet state. The cloud caused by the malicious explosion at Stowmarket has passed away; the works there have arisen from their ashes; the government works at Waltham Abbey, suspended after the fatal catastrophe of 1871, have been completed and are in full operation; and there seems a useful future for gun cotton as an efficient and powerful explosive agent.

The compressed gun-cotton discs are now much employed for destructive purposes in warfare, having been used notably in blowing up the forts and guns in the late bombardment of Alexandria. These discs, so destructive when fired by a detonator, burn harmlessly but rapidly when ignited by a red-hot wire, and give an intense yellow, mono-chromatic light, due to the presence of a little soda. The formula of gun cotton is $C_6H_7(NO_2)_3O_5$. It is insoluble in alcohol and ether, thus differing from xyloidin, $C_{18}H_{23}(NO_2)_7O_{15}$, which is another nitro-cellulose, prepared in a similar manner, and the solution of which in ether and alcohol forms the collodion used in photography. Gun cotton burns with great rapidity, and can easily be fired over gunpowder without inflaming it. Gun cotton gives no smoke in combustion, and has this great advantage over gunpowder. The gases produced are principally carbonic oxide and carbonic acid, with marsh gas, nitric oxide, and nitrogen. The blasting power of gun cotton, as compared with gunpowder, increases with the resistance to be overcome; in artillery it is three to one, in hard rock it is six to one.

Cotton gunpowder is gun cotton pulverized and converted into a fine cream-coloured powder. It possesses in this state the same violently destructive power, and for some purposes is more convenient.

GUN LICENSES. By the Gun License Act, 1870, persons carrying guns or firearms of any description are required to take out an annual license at a cost of 10*s*., renewable on the 31st of March in each year, and the using or carrying of a gun without such license incurs a penalty of £10. The following are exempted from the provisions of the Act:—Persons in the naval, military, or volunteer force, when on duty or at practice; persons holding a license to kill game; those using guns solely for scaring birds or killing vermin, where the occupier of the land holds a game certificate; gunsmiths and carriers in the ordinary course of trade. Constables are empowered to make such inquiries as may be necessary for the purposes of the Act.

GUN'JAH, the Indian name for the dried hemp plant (*Cannabis sativa*) before the resinous juice has been removed. It is chiefly used for smoking with tobacco.

GUNNEL. See Butter-fish.

GUNNERY is that branch of the science of artillery which comprehends the theory and practice of shooting. Though firearms were in use in the fourteenth century, little of any value was understood of the laws regulating the flight of projectiles till the time of Nicholas Tartaglia, who published a treatise on the subject at Venice in 1537. Before this time it had been generally believed that a ball on leaving the bore of a gun proceeded for some distance in a straight path. Tartaglia, however, saw that "a piece of artillery cannot shoot one pace in a right line," and he propounded the axiom that "the more swifter a pellet doth flie, the lesse crooked is his range"—a truth expressed at the present day by the statement that a high velocity gives a flat trajectory. Galileo showed that the path of a projectile, supposed to move without resistance, is always a parabola. Subsequent writers, with the exception of Newton and Bernoulli, till the time of Robins, 1742, assumed that the atmospheric resistance was but nominal, and consequently asserted that all shot described parabolas in their course. The real founder of the science of gunnery was Benjamin Robins, whose work, "New Principles of Gunnery," appeared in 1742. It appeared from Robins' experiments, that the resistance of the air to an iron ball $4\frac{1}{2}$ inches in diameter, moving at the rate of 800 feet per second, was equal to four times its weight; and that up to 1100 feet per second the resistance increased nearly as the square of the velocity; above 1100 feet per second, that it was three times as great as it should be by comparison with the lower velocities. By means of the ballistic pendulum he measured the speed of balls at the very cannon's mouth. Using the work of Robins as a basis, Euler, towards the end of the eighteenth century, extended our knowledge of this subject considerably. Dr. Hutton laboured successfully in the same field. From the experiments of the latter it was found that the resistance that shots meet in passing through the atmosphere is in rather a higher ratio than the squares of the diameters of the balls. It was found also, that there is a gradual increase in the exponent of the resistance as the velocity increases up to 1600, and after that a decrease.

Further experiments by Generals Piobert and Didion of the French artillery, and by Captain Walter and M. Helié, both teachers in schools of artillery, went to show that the resistance of the air was more nearly as the *cube* of the velocity of the bullet; but it was not till Professor Bashforth carried out, between 1865 and 1870, a series of systematic experiments with spherical and ogival-headed projectiles, by means of his clock *chronograph*, that any accurate knowledge of the subject was obtained. His conclusions were that between 900 and 1100 feet per second the resistance varies in the proportion of the *sixth* power of the velocity, between 1100 and 1350 of the *cube*, and above 1350 of the *square*. When a body passes swiftly through the air, it condenses the air in front of it into a sort of elastic cushion, through which it has to plough its way, while a partial vacuum is formed in rear of it. The power of the body to maintain its velocity is in direct proportion to its weight, but in inverse proportion to its transverse section. And since, in the case of spherical or cylindrical projectiles, the transverse sections are as the squares of the diameters, the power of maintaining velocity may be expressed by the quantity $\frac{w}{d^2}$, where w is the weight and d the diameter of the projectile. If we take the case of two different sized solid spheres of the same metal moving with the same velocity, we may write d^3 instead of w, because similar solids are as the cubes of their like dimensions, and the above expression becomes $\frac{d^3}{d^2}$, which is equal to d; or in other words, the power of solid round shot is proportional to their diameters. For instance, a 6-inch round shot has twice as much power of maintaining its speed as a 3-inch shot. And similarly solid shot will range much further than hollow shot.

One of the greatest mechanical aids to perfection in the art of gunnery has been that of rifling—a process the great advantage of which was long recognized in small arms and sporting pieces before it was extended to ordnance. [See Rifles.] The first rifled arms threw bullets which, except for certain projections designed to fit the grooves of the barrel, were spherical. These guns surpassed smooth-bores in accuracy, but it was not till the introduction of elongated projectiles that a distinct gain in power was recognized. The gain in accuracy is due in

great measure to the superior correctness with which the ball is centred in the bore by the action of the grooves, whils the rotation imparted to it annuls or greatly lessens the disturbing effect of the pressure of the air on surface inequalities, or of variations in the position of the centre of gravity. The path of a round shot is uncertain, because it is difficult to get the powder to act centrally on it on account of the necessary *windage* or space between the bullet and the barrel; moreover, it generally leaves the barrel spinning in some direction or other, which causes a greater pressure of the air on one side than on the other, and deflects the bullet from its course. An elongated shot, by means of the spinning motion imparted to it round its longer axis, is enabled to travel point first, and as the resistance of the air depends upon the area of the transverse section, a far greater weight can be given to the long than to the round shot without increasing this resistance. Thus, in addition to greater accuracy, rifling confers a flatter trajectory and greater penetration. The shape of the point of the shot affects the resistance of the air chiefly as to the length of the radius of the curve at its junction with the cylindrical part of the projectile. A hemispherical head encounters the greatest, and a long pointed or ogival head the least resistance; but there is very little difference between the latter and an egg-shaped or hemispheroidal point. Measuring the power of elongated projectiles to maintain their velocity in the manner just described, we shall find that it is directly in proportion to their *absolute* length for similar velocities; for their weights are as their contents, or as d^2l, and their transverse sections are as d^2; therefore $\frac{w}{d^2}$ becomes $\frac{d^2l}{d^2}$ or l. This explains the direction in which rifle bullets are being improved, by increasing their length and reducing their diameter. But the longer a bullet is the more spin it requires to keep it steady, and practically the length of a bullet or shot is limited to about three times its diameter. As an instance of the actual resistance of the air in pounds to the passage of a projectile through the air, it may be mentioned that accurate experiments have shown that an ogival-headed shell 16 inches in diameter, moving with a velocity of 1600 feet per second, encounters a total resistance of 2899 lbs., or over $1\frac{1}{4}$ tons. The resistance of the air to a pointed or ogival-headed bullet of 1 inch diameter moving at the rate of 1000 feet per second, has been calculated to be 2·32 lbs., and that of the same bullet at 1500 feet per second to be 10·19 lbs. The better the penetrative power of a gun is understood, and the more accurately the rate of flight of a projectile can be ascertained, the greater are the chances of really good shooting. The varied descriptions of targets constantly being experimented upon show the penetrative power of ordnance, while the velocity of a projectile's flight, after leaving the gun, is easily found by the various kinds of chronographs. By Captain Noble's ingenious chronoscope, described further on, the rate of the shot's progress even within the gun can be determined.

The following table gives an idea of the actual effect of the resistance of the air on the speed of a projectile :—

	Weight of Projectile	Velocity at Muzzle.	100 Yards.	200 Yards.	300 Yards.	400 Yards.		1000 Yards.	1500 Yards.	2000 Yards.	2500 Yards.	3000 Yards.
9-inch, 12-ton,	258 lbs.	1420	1401	1382	1363	1345		1242	1168	1102	1048	1006
Difference of velocity, .		—	19	19	19	18	18	85	74	66	54	42
Martini-Hen. Rifle, . .	1 oz.	1315	1167	1053	982	922	869	664	621	585	—	—
Difference of velocity, .		—	148	114	71	60		205	43	36	—	—

The difference of power of large and small projectiles is well illustrated by the fact that the highest point of the path of an 11-inch shell above the horizontal plane in travelling over 2000 yards is about 33 yards; for the same range the Martini-Henry rifle bullet reaches a height of about 81 yards, or nearly two and a half times as much as the shell, both being projected with the same velocity. If both weapons were to discharge their projectiles with the same angle of elevation—viz. that sufficient to throw the rifle bullet 2000 yards (7° 26′)—the gun would throw its shell about 3700 yards.

Comparatively little was known of the work done by the explosion of gunpowder in guns until it was made the subject of inquiry by Captain A. Noble, late R.A., F.R.S., and Professor (now Sir Frederick) Abel, F.R.S. The results of their experiments are expressed by connecting the number of volumes of expansion of the powder charge in the bore of a gun with the maximum work per pound of powder which the powder is capable of realizing. Thus if the charge occupied one-sixth of the whole bore, no matter what the diameter, it was found that the work performed on the shot by each pound of powder was 90 foot-tons (*i.e.* a power which could raise 90 tons through a height of one foot). The smaller the length of the charge in proportion to the length of the bore the greater the work done.

High muzzle velocities are obtained, as one would suppose, by burning large charges of powder; but the small-grained quick powders formerly used are unsuitable to modern heavy guns, which fire shells up to three-fourths of a ton in weight. Such masses of metal cannot be moved by a smart blow such as a quick-burning powder gives without great danger to the gun and to the shell, especially when it is remembered that the shell has to be made to twist in the grooves of the rifling. The shell must, as already explained in our article on GUN, be started with a push, as it were, and then the whole of the power applied to produce the desired velocity. This is precisely what is done by using a slow-burning powder, having grains from the size of small pebbles to $1\frac{1}{2}$-inch cubes, according to the size of the gun. The rifling is also made with what is called an *increasing twist*, that is, it commences parallel to the axis of the bore and gradually gains the desired degree of spirality, thus avoiding too sudden a strain to the gun or projectile. In a very heavy gun, with a charge of cubical powder, the shell has generally moved about 6 inches forward before the maximum pressure is set up, and as it still continues to move the volume of the gas is increasing and the pressure diminishing. The great end to be attained is to keep the maximum pressure as low as possible and to sustain it for as long as possible, so as to impart the greatest velocity to the projectile. Great advances have been made in this direction of late years, larger charges having been burnt with actually less strain to the gun. If all the powder were fired instantaneously there would be a pressure of about 38 tons to the square inch on the chamber of the gun, but by the above means

this is reduced to 20 tons or less. By enlarging the powder chamber of the gun in diameter a small gun may be made practically to burn the charge of a larger one, and the cartridge being shortened better mechanical conditions of ignition are produced, tending still more to lessen the strain; it has also been discovered that by allowing spaces of air in the powder, and thus diminishing the total density of the charge, the maximum pressure is still further diminished. Thus, by a careful study of the theory of combustion combined with experiment, guns are now being made to propel their projectiles with an increase of nearly 50 per cent. of velocity and no more strain to themselves. The prominent outward feature of these guns, viz. their great length, is of course necessary for the perfect combustion of the slow-burning powder, while a return to the system of loading at the breech gets rid of the difficulty of great length as applied to the muzzle-loading system. For a description of the construction of guns see GUN.

It is usual to measure the power of guns by the *energy* of the shot, that is, the amount of work it is capable of performing, expressed in foot-tons. The energy at any moment of the shot's course depends upon its weight and the velocity with which it is travelling. This is arrived at in the following manner:—

The *work* performed by any pressure is the product of that pressure and the space through which it acts; for instance, if a weight of 224 lbs. is lifted through a space of 100 feet, the work done is said to be 22,400 *foot-pounds*, or, dividing by 2240, 10 *foot-tons*. Now if we suppose a shot of 224 lbs. weight, travelling with a velocity of 1000 feet per second, to be suddenly diverted from its path into a vertically upward direction, it would rise to a certain height before it commenced to descend again; this height is given by a common dynamical formula, and is the square of the velocity divided by twice the accelerating force of gravity (32·2 feet per second). In the supposed case, therefore, the height in feet to which the shot would ascend is $\frac{1000^2}{64{\cdot}4}$, and the work capable of being performed by the shot is the product of this quantity and the weight—viz. $\frac{224 \times 1000^2}{64{\cdot}4}$ foot-pounds; or, reducing it to tons, $\frac{100000}{64{\cdot}4}$ foot-tons = 1552 foot-tons; but as in this case the penetrative power of the shot, into iron, for instance, depends upon the surface over which this pressure acts, we arrive at an expression for comparing the penetrative power of different guns by dividing by the number of inches in the shot's circumference; and if the diameter of the 224-pound shell is 9 inches, its circumference is, roughly speaking, 27 inches, and we get as the *energy per inch of shot's circumference* $\frac{1552}{27}$ foot-tons = 57 foot-tons approximately.

The following table shows the energy of different guns:—

Diameter of gun, . .	7-Inch.	9-Inch.	10-Inch.	12-Inch	16-Inch.	17·72-Inch.	6-Inch.
Weight of gun, . .	7 Tons.	12 Tons.	18 T.		80 Tons.	100 Tons.	81 Cwt. Latest Pattern.
Weight of projectile,	115 Lbs.	258 Lbs.	410 l	714 Lbs.	1700 Lbs.	2000 Lbs.	80 Lbs.
Muzzle velocity (feet per second), . .	1540	1420	1364	1300	1601	1548	1881
Energy at muzzle (foot-tons), . . .	1891	3607	5288	8367	30329	33233	1962
Penetration into iron armour at 1000 yards, in inches, ...		10·2	12·2	14·9	23·3	22·8	8·4

From the above will be seen at once the advance that has been made in artillery science; for the penetration of the 4-ton gun with an 80-pound projectile into iron armour exceeds that of the 7-ton gun with a 115-pound projectile. The energy of a shot at the muzzle, as given above, also furnishes the means of estimating the mean pressure exerted on the base of the shot in the bore of the gun during its passage through it; for the energy at the muzzle is evidently equal to the work done on the shell when it has reached the muzzle; and this latter is represented by the mean pressure on the shell multiplied by the distance through which it has acted—viz. the length of the bore. If therefore the muzzle energy and length of bore are known, the mean pressure can be deduced therefrom.

The amount of the recoil of a gun has to be taken into consideration, on account of the destructive effect it may exercise on the carriage. The velocity of recoil is generally taken as the velocity of the gun and carriage on discharge, and is greatest when the projectile leaves the muzzle. The mathematical measure of the *momentum* or quantity of motion of a moving body is the product of its mass and velocity, or for practical purposes of its weight and velocity. Action and reaction being equal, the momentum of the shell is equal to the momentum of the gun and carriage. From this consideration we can determine the velocity of the gun and carriage for a given weight, or the necessary weight to produce not more than a certain velocity of recoil. This is most necessary in designing a gun; for if it is too light it becomes unmanageable, and on the other hand there is a practical limit to the weight of guns which have to be capable of more or less rapid transport, such as field and siege guns.

In the 9-pounder field gun, for instance, weighing 8 cwt., and its carriage about 11 cwt., the velocity of recoil is about $6\frac{1}{2}$ feet per second, and the work done (which can be easily calculated in the manner above explained) is 1538 foot-pounds. The velocity of recoil of the 80-ton gun is about 11 feet per second, and the energy 550,300 foot pounds. The energy of recoil may be reduced by either decreasing the weight of the projectile, decreasing the muzzle velocity, or increasing the weight of the gun and carriage. If the weight of the projectile be decreased the gun will have less range and penetration; if the muzzle velocity be lessened, the trajectory will not be so flat and the accuracy not so great. The disadvantage of increasing the weight of the gun and carriage for certain purposes has been already referred to. When the recoil cannot thus be reduced within reasonable bounds, it must be checked by mechanical means. Some guns are designed on purpose to throw heavy shells with low velocities, in order that they may surmount objects intervening; these are called *howitzers* or *mortars*. Others are intended to fire the maximum of powder so as to produce the highest velocities and greatest shattering effects.

A few words must now be said about the causes which affect the trajectory or path of a projectile. As soon as it leaves the bore it is drawn down out of the direction in which it started by the force of gravity, and would, if the air offered no resistance, describe a parabola, as we have already seen. But the resistance of the air causes it to fall away from this curve, and to describe a path which cannot be determined by theory alone. The results of careful experiments, however, combined with theoretical formulæ, have enabled Professor Bashforth to compile tables by

which the velocity, time of flight, and path of the projectile can be determined with surprising accuracy. For artillery practice some other causes of irregularity of flight have to be taken into account, and allowed for either in the construction of the gun itself or in its use. One of these is the fact that an elongated projectile, spinning on its longer axis, as soon as it begins to be acted upon by gravity, does not move with its longer axis truly coincident with its path, and the air's resistance acts therefore to a certain extent in a direction oblique to the axis; this, by a well-known mechanical law, which can be illustrated by the philosophical instrument known as the gyroscope, causes it to gyrate and to deflect or *drift* away from its original course in a direction depending partly on the way in which it is rotating, and partly on the shape of the head. The more accurately a shot is centred in the bore, the less error will arise from this cause. There are three methods of giving rotation in ordnance—viz. by a soft metal coating round the projectile slightly larger than the bore, which is forced into the spiral grooves; by means of *studs* on the projectiles, fitting the spiral grooves of the bore; by means of a metal disc attached to the base of the projectile and expanded into the grooves by the explosion of the powder. In the first and last of these systems the centring is the most perfect. The rifling of British guns gives a right-handed rotation—*i.e.* when standing behind the gun the shell rotates in the same direction as the hands of a clock. In this case, when the point is rounded or ogival, the drift is to the right, and being nearly constant, is allowed for in the sighting of the gun. If the head of the shot is flat the drift will be to the left. The results would be reversed if the rotation of the shell were left-handed.

Another cause of error is in the *jump* which a gun gives on firing, which may vary if the recoil is not similarly checked at each round. Again, if one wheel of a gun is lower than the corresponding wheel on the other side of the carriage, the gun will throw towards the side of the lower wheel.

The descriptions of projectiles fired from guns will be found described under PROJECTILES. The fire of ordnance is defined in the British service as to its curve by the terms *direct*, *indirect* or *curved*, or *high-angle*. It is called direct when full charges of powder are used with elevations not exceeding 15 degrees; this elevation practically includes very long ranges under such conditions. Indirect or curved fire is that from guns, howitzers, or mortars with reduced charges, with elevations not exceeding 15 degrees; this is used to disperse troops hidden by intervening ground, or to breach walls, parapets, &c., not exposed to the view of the battery. For use against troops shrapnel shells should not have a less velocity than 500 feet per second at the end of their flight; the velocity of a projectile at any point in its flight is called its *terminal* velocity. For breaching a brick or soft stone wall the projectile should strike it at an angle not greater than 15 degrees from the perpendicular, with an energy not less than 80 foot-tons.

High-angle fire is that from guns, howitzers, and mortars, at elevations exceeding 15 degrees. It is used to penetrate overhead cover. The shell of the 8-inch howitzer (weighing 180 lbs.) will penetrate about 4½ feet of earth at 1800 yards, or 6 feet of earth and 2 feet of brick arch at long ranges. Fire is defined as to its direction by the terms *front* or *frontal*, *oblique*, *enfilade*, and *reverse*; these terms explain themselves.

The rate of firing does not depend so much on the time occupied in loading as on that expended in efficiently laying the gun. Field guns can be fired with percussion fuzes against troops six times in a minute; with time fuzes four times in a minute.

Troops cannot move in bodies with impunity at any distance under 4000 yards in front of guns when the atmosphere is clear and the ground open. Shrapnel can be used with considerable effect against skirmishers, even at 2000 yards range. At ranges varying from 1625 to 2250 yards a battery of six 9-pounder field guns in eight rounds per gun disabled seventy men of a half battalion of 400 advancing with skirmishers, supports, and reserves ("Okehampton Experiments," 1875).

For night firing, siege guns are provided with scales hanging from their carriages, the position of which with reference to a chalk line drawn on the platform determines the direction in which the gun is pointing; elevation is in this case given by a CLINOMETER.

Instruments used for determining velocities of projectiles, &c.—The chronoscope, invented by Captain Noble in 1869, consists of a series of metal discs, which, on the turning of a handle, rotate with great rapidity—125 times in a second. When required for use the discs are coated with lampblack; in front of each one a metallic pointer is placed, and the whole apparatus is connected by wires with an electric battery and with the gun. But how is the passage of the shot inside the thick heavy tube to be noted? In this way. Holes are bored 6 inches apart through the substance of the gun from the outside to the bore. In these holes a kind of hammer connected with the wires is suspended. As soon as the shot begins to move the hammer in the first hole breaks the wire; a spark from the electric battery immediately flies from the pointer above mentioned, and makes a bright spot on the disc. The same thing is repeated as soon as the shot reaches the second hole, and so on through the length of the gun; and as the rate of movement of the discs is known, the bright spots imprinted thereon become records of the rate of movement of the shot or projectile through every 6 inches of the gun.

For determining the time of flight of a projectile over a certain space the Boulengé chronograph is that which is generally used. The principle of measurement is the space through which a metal bar, liberated at the moment the shot leaves the muzzle, will fall during the flight of the projectile; the time is then calculated by the well-known dynamical laws respecting falling bodies. The instantaneous record of the moment of firing and striking is obtained by means of electricity. As the shot leaves the muzzle it breaks a fine wire which forms part of an electric circuit, and liberates the falling bar of the instrument by demagnetizing an electro-magnet; on striking the target or screen at the given distance a second circuit is broken, and a mark is made on the falling bar by means of a knife edge, which, acted on by a spring, strikes it horizontally. In this way the mean time of flight is obtained, and by calculation the muzzle and striking velocities are obtained.

For measuring the pressure in the bore of a gun, metal plugs are screwed in from the outside at the points where the pressure is to be determined. Inside these plugs are small cylinders of homogeneous copper, which, on the explosion of the charge, are compressed. The amount of compression undergone, compared with the effects of known pressures, determines the pressure required with sufficient accuracy for practical purposes.

For detailed information on gunnery see the "Handbook for Field Service," published by authority.

With the introduction of breechloading guns there were several concurrent improvements in gun platforms. In the article on GUN we have described some important modifications carried out by Sir William Armstrong, while under ARTILLERY there is a Plate and description of Major Moncrieff's ingenious invention for mounting guns, whereby they can be raised or lowered at will, for firing *over* walls or turrets instead of through open embrasures. The barbette system was tested at the bombardment of Alexandria in 1882, with the most satisfactory results. The usual method of loading and training the guns of the turret

ships, while having the advantage of complete protection, is both slow and cumbrous. In order to move the guns, which are the only things which are wanted to move, the whole mass of the turret must be rotated. If they are fired on the port beam, they must be depressed and revolved to the starboard position; and if they are fired on the starboard beam they must be depressed and revolved to the port-loading position, and then moved back again to port or starboard, as the case may be, for laying. This involves considerable loss of time, and the comparative deliberation of the *Inflexible's* fire, on the occasion of the same bombardment, enabled the Egyptian gunners to wait their time, and to take advantage of the interval which they knew must occur between the rounds to work their guns, rushing back to cover the moment they saw the open ports of the turret ship bearing upon them. In the *Téméraire*, with barbette mounting, the gun only moved, the turret being fixed. It could not be seen by the enemy, it fired from a height with a practically all-round fire, disappeared after discharge, and was brought back to the firing position, not by a system of counter-weights, which would double the weight of the gun, but by hydraulic force acting upon a cantilever. The force of recoil was, under the hydraulic system, used to depress the breech to the loading position automatically, and thus proved economical with respect to time, weight, and gear. As the turrets have not to be moved, these can be armoured to any degree of thickness. The counterweight system of Major Moncrieff has its advantages in land works, where the extra weight is of little consequence.

GUNNY is a coarse kind of cloth made from the same plants as JUTE—*Corchorus capsularis* and *Corchorus olitorius*. When the long silky fibre is stripped from the stems of these plants, the short and inferior pieces are generally woven into gunny. This coarse cloth is used by the very poorest as clothing and bed-covering, but is chiefly employed to make gunny-bags for shipping rice, cotton, &c. It was formerly spun almost exclusively by the Hindus of Lower Bengal—all classes, rich and poor, employing their spare time in this way. It "forms the never-failing resource of that most humble, patient, and despised of human beings, the Hindu widow, saved by law from the pile, but condemned by opinion and custom for the remainder of her days literally to sackcloth and ashes, and the lowest domestic drudgery in the very household where once, perhaps, her will was law" (Royle's "Fibrous Plants of India"). Mills were started in Dundee for the manufacture of gunny, and immense quantities were supplied to the whole world; but by improved machinery Bengal now successfully competes with Dundee.

GUNPOWDER, a mixture of nitre, sulphur, and charcoal, possessing great explosive power on ignition. The ingredients vary according to the use proposed:—

	Common Gunpowder.	Sporting Powder.	Mining Powder.
Nitre,	75	78	65
Charcoal,	15	12	15
Sulphur,	10	10	20

The composition varies also in different countries, each having its own formula, as shown in the following table:—

	Nitre.	Charcoal.	Sulphur.
English,	76·2	13·7	10·1
French,	76·9	13·5	9·6
German,	73·7	10·7	15·6
Italian,	73·2	18·2	8·6
Austrian,	75·6	13·1	11·3
Swedish,	75·0	9·0	16·0
Swiss,	76·0	14·0	10·0
Russian,	70·6	17·7	11·7
Chinese,	61·5	23·1	15·4

Gunpowder was used in the form of rockets by the Chinese 200 years B.C. It was also employed by the Greeks in making fireworks. It has been asserted, upon doubtful evidence, that the knowledge of this substance was conveyed to Europe from the Arabs by the Crusaders; and it has been further alleged that the Arabs employed it at the siege of Mecca in 690, and that they obtained a knowledge of it from India. The earliest authentic record that we have of this composition is to be found in a work written by Roger Bacon at Oxford in 1216, and entitled "The Secrets of Art and Nature;" wherein he states that "from saltpetre and other ingredients we are able to make a fire that shall burn at what distance we please, and that sounds and coruscations resembling thunder and lightning might be formed in the air, much more to be dreaded than those that happen naturally, inasmuch as by its power armies and cities might be destroyed." Roger Bacon has been supposed to allude in an enigmatic way, by a formula of Latin words, to the composition of gunpowder. A knowledge of its destructive power, and the advantages to be derived from it in war, is said to have originated early in the fourteenth century through an accidental discovery of Bartholdus Schwartz, a German chemist; while operating in a mortar with a pestle on a mixture of charcoal and nitre, an explosion occurred which blew the vessel to a considerable distance. The introduction of cannon into the operations of warfare by sea and land soon followed the discovery of gunpowder, as we find the Moors using artillery against Alonzo, king of Castile, in 1343 and 1346. Edward III. of England used five field-pieces against the French at the battle of Crécy in 1346. Cannon, and of course gunpowder, are said to have been first employed for naval purposes on the Baltic Sea in 1350, and by the Venetians in 1380.

In the manufacture of gunpowder the nitre (potassium nitrate) and sulphur must be pure, the charcoal carefully selected and prepared, and the whole perfectly mixed in fine powder. This mixture is moistened, ground, and pressed into a cake; it is then dried and granulated, and, associated with plumbago in fine powder, it is afterwards polished by attrition in revolving barrels. The rapidity of its combustion depends on the size of the grains, which vary from the size of millet seed, as used in fowling-pieces and rifles, to the size of a nut, as used in mining, or to the pebble powder, up to the size of large potatoes, as used in the 80-ton gun and other large pieces of ordnance. It is absolutely necessary in all arms, from rifles to artillery, that the combustion should be regulated to the size of the shot to be discharged. The larger the shot the more gradual must be the force developed to overcome its inertia; if the powder all exploded instantaneously the piece would be shattered before the shot began to move. The corning or graining of the powder is effected in wooden mortars by wooden pestles actuated by machinery, and a certain number of blows is given to a definite amount of the material. Parchment sieves are in succession employed to separate the grains of a required size from the pulverized mass. The process of glazing the powder by attrition then follows the operation of graining. Another method is that of pressing the composition into a firm cake, after which it is broken up into small lumps, and the graining process is conducted in revolving sieves, each containing a flat circular piece of lignum-vitæ. The sieve-holes are sized, to permit the escape through them of the grains as they are formed by the abrading action of the plate of wood. The grains are separated from the dust by sieves and reels; they are then hardened, and the rougher edges are taken off by being run a sufficient length of time in a close reel, with a circular motion. The temperature at which gunpowder explodes is about 600° Fahr. Powder for blasting contains a larger amount of sulphur, which in ordinary powder would foul the gun.

White Gunpowder.—The composition of this substance is as follows:—

Chlorate of potash, . .	48
Yellow prussiate of potash,	29
Finest loaf-sugar, . . .	23
Parts by weight, ...	100

The yellow prussiate must be dried in an iron ladle until it is as white as the chlorate. The ingredients are ground separately, and mixed by means of a conical sieve until they are thoroughly incorporated. In loading it is treated the same way as ordinary gunpowder, being pressed down by hand solid, but not hard. The charge is ignited in the usual way, either with a common cap and nipple, or in a rim or central fire cartridge. No alteration is required in the gun, but the cartridge case must be little more than half its usual length, which gives the same result as double the quantity of gunpowder, but with greater quickness, penetration, and accuracy. Another explosive agent has recently been introduced, which is said to be very much stronger than gunpowder. It consists of a mixture of chlorate of potash and tow.

Protected Gunpowder—the invention of Mr. Gale—is a method of rendering ordinary gunpowder inexplosive. The means employed for this purpose is simply glass ground down to an exceedingly fine powder, which, on being mixed with the gunpowder, prevents it from exploding, even if touched with a red-hot iron. Three pounds of pounded glass to one of the powder are found to be the safest proportions. With equal parts of each the gunpowder will burn, but not explode. Slow matches may be burned in vessels holding gunpowder mixed with the protective powder, and they only serve to ignite a few grains. A red-hot poker may be stirred through the mixture without ignition. The mixture can be stored in magazines or on shipboard, or transported by land without risk. When required for use the glass is sifted out through a fine sieve.

The charcoal from willow wood is the best for making gunpowder. An excellent powder, called brown powder, is made in Germany from charcoal which is not fully carbonized, but treated with superheated steam and torrefied to a reddish-brown colour; the charcoal may be made from wood, peat, or light peat moss.

The explosive force of gunpowder is due to the large volume of gases suddenly evolved in its combustion, amounting to more than 1000 times the volume of the powder; and this volume is much increased by the high temperature evolved in the combustion. The initial maximum pressure on the interior of the gun was estimated by Bunsen at 4374 atmospheres, or 65,610 lbs. on the square inch, but this of course varies with the size of the powder grain used. Theoretically the gases evolved are nitrogen and carbonic acid, and the decomposition may be represented as follows:—

$$2KNO_3 + S + C_6 = K_2S + 2N + 3CO_2,$$

potassium sulphide being the only residue, and this forms the fouling of the gun. Practically, however, the decomposition is not quite so simple, for carbonic oxide, hydrogen, sulphuretted hydrogen, oxygen, and marsh gas are all found in small quantity among the gases evolved. Gunpowder is a simple mechanical mixture: the nitre can be easily dissolved out by water; the sulphur can then also be separated from the residual charcoal by simple solution in carbon disulphide.

Attempts have been made at various times by Dr. Hutton, Count Rumford, and others to measure the force of gunpowder, but it is only within recent years that, by the combined efforts of chemists and mathematicians, science has advanced far enough to render a definite answer to the problem. It was found that by the explosion of powder in the chamber of an 81-ton gun heat was generated equal to 4000° Fahr., being far more than sufficient to melt iron, and that the pressure exerted amounted to 46 tons per square inch. The heat, owing to the ejection of the shot, was but momentary, but no gun could stand the frequent repetition of such enormous pressure from inside without serious damage, and eventually rending open. Of course the larger the bore the greater the number of square inches exposed to this dangerous pressure, and hence the chief difficulty of increasing the size of guns.

These difficulties were gradually overcome, so that it became possible in 1878 for Woolwich to undertake to turn out a gun of 100 tons, and to insure that, notwithstanding a huge charge of more that 400 lbs. of powder, the pressure within the gun should not exceed about 20 tons per square inch. And this result has been obtained chiefly by modern science being now able to calculate mathematically what the power of a given quantity of gunpowder will be, and by modifications in its manufacture to regulate to some extent its explosive force.

The explosion of powder is only *instantaneous* in appearance. The time occupied in the burning of the charge may be exceedingly small, but scientifically speaking there is a very appreciable duration of time between the first ignition of a charge of gunpowder and the conversion of the whole mass into gas.

It being thus a recognized fact that the combustion of gunpowder is not instantaneous, the problem was how to still further prolong the period occupied in the process. If the powder at the rear of the shot were to explode instantaneously, then the maximum pressure would be brought violently against the inner surface of the gun, and the utmost possible damage would be done to the gun, probably even to bursting it; while the shot would be sent out by the force of a smart *blow*. If, on the other hand, the powder burned comparatively slowly, the shot would have begun to move before the maximum force of the powder was exerted; and while the pressure within the gun would be reduced, the effect upon the shot would be a prolonged *push*.

It is found that by manufacturing the powder in large grains, and making what is known as "pebble powder," these results can be obtained, inasmuch as a large grain takes a longer time to burn than a small grain—somewhat on the same principle of small pieces of coal burning through more rapidly than the same weight of coal in one lump. By means of this pebble powder therefore a sufficiently high velocity can be communicated to the shot without overstraining the gun. We have thus been led to increase the size of cannon powder from small grains to large lumps. A bag of onion-seed would fairly represent the charge of the 68-pounder in 1857, while a large sack of potatoes is suggested by the charge of the monster guns which were being manufactured in 1884.

The value of the exports of gunpowder from the United Kingdom amounts to nearly £500,000 yearly.

Laws relating to Gunpowder.—In consequence of its very dangerous nature, the manufacture, carriage, and storage of gunpowder are regulated by several stringent Acts of Parliament. Every mill in which it is made must be licensed, and only 40 lbs. must be dried at one time. Safe magazines for the storage of the powder have to be made at a distance from every mill, and the powder must be conveyed there as soon as possible after its manufacture. No dealer must keep more than 200 lbs. weight on his premises at one time, and no more than 300 lbs. must be kept in store for mining purposes. Not more than 30 lbs. are to be carried by any land carriage unless in a van specially constructed, and then 40 lbs.; or unless such carriage form part of a railway train, and then 80 lbs. All vessels, unless belonging to the navy, coming into the

Thames have to put on shore, at or below Blackwall, all the gunpowder they have on board except 25 lbs.; and vessels outward bound are not to receive on board more than 25 lbs. previous to their arrival at that place. Warrants may be issued for searching in any places where gunpowder is suspected to be unlawfully secreted, or where more than the legal quantity is kept.

GUNPOWDER PLOT, a formidable Roman Catholic plot at the beginning of the reign of James I., which sprung from the discontent that had been felt by the great body of Roman Catholics in England, occasioned by the harsh measures adopted against them by James I., so harsh indeed that over 6000 were punished in one year for recusancy.

The design of blowing up the House of Lords with gunpowder at the opening of Parliament, and thus destroying at a single blow the King, the Lords, and the Commons, was formed about the summer of 1604, and it was united with a scheme for carrying off a member of the royal family. Prince Charles was considered the most likely, and the design was to proclaim him king. The conceiver of this desperate and bloody vengeance was Robert Catesby, a Catholic, and son of Sir William Catesby, who had been several times imprisoned for recusancy. Catesby disclosed his scheme to John Wright and Thomas Winter, the former descended from a respectable family in Yorkshire, the latter from the Winters of Huddington in Worcestershire, where they had been in possession of estates since the time of Henry VI. Winter introduced Guido or Guy Fawkes, whom he had brought from the Netherlands. Fawkes was a gentleman of good parentage and respectable family in Yorkshire; his father, Edward Fawkes, was a notary at York, and held the office of registrar and advocate of the consistory court of the cathedral. Of Guy's education and early history nothing is known, but he had served in the Spanish army in Flanders. Soon after Winter's return to London, Thomas Percy, the relation and confidential steward of the Earl of Northumberland, joined the four conspirators already mentioned. Percy took the next step. He hired the house adjoining the Parliament House, and after some preliminary steps, they commenced on 11th December, 1604, to form a mine. Parliament had been prorogued to February 1605, but was again prorogued from February to October. They proceeded with their operations; but before they had got through the thick wall, they were enabled to hire a vault immediately under the House of Lords, which had been occupied by one Bright for the sale of coals. About twenty barrels of powder were conveyed thither; iron bars and other tools that had been used in mining were also thrown among the powder, that the breach might be the greater, and the whole was covered over with faggots. Lumber of various kinds was placed in the cellar to prevent any suspicion of the curious or the watchful. In May, 1605, the preparations were complete; the conspirators, having marked the door, in order that it might be seen if anyone entered the vault in their absence, consented to separate. Fawkes was despatched to Flanders for the purpose of conferring with Sir W. Stanley and Owen, whom it was desired to add to the plot. Soon after his return from Flanders, the Parliament was further prorogued from October to the 5th of November. These repeated prorogations alarmed the conspirators, and led them to fear that their project was suspected. Their alarms, however, having been discovered to be groundless, Catesby purchased horses, arms, and powder, and, under the pretence of making levies for the archduke in Flanders, assembled friends who might be armed in the country when the first blow was struck. As considerable sums of money were necessary for these purposes, it was proposed to admit into the confederacy three wealthy men, Sir Everard Digby [see DIGBY], Ambrose Rookwood of Coldham Hall in Suffolk, and Francis Tresham, the son of Sir Thomas Tresham, of Rushton in Northamptonshire. These gentlemen were afterwards sworn in, and Digby lent them £1500.

As the day of meeting of Parliament approached, it was finally determined that Fawkes should fire the mine with a slow match, which would allow him a quarter of an hour to escape. One subject of discussion only arose, whether and how the Roman Catholic peers should be warned of their danger; but the danger of communicating the project to so large a number of persons was considered so imminent that they despaired of saving all of them, and it was concluded that no express notice should be given them, but only such persuasion, upon general grounds, as might deter them from attending. Many of the conspirators were averse to this advice and angry at its adoption; and Tresham in particular, for his sisters had married Lords Stourton and Mounteagle: and from this time he ceased to attend the councils of the conspirators.

On Saturday, the 29th of October, ten days before the meeting of Parliament, Lord Mounteagle received a letter from one of his pages, who stated that he had received it in the street from a stranger, who pressed its instant delivery into his master's hands. The letter was vague, but alarming, and it is probable was written by Tresham. Mounteagle showed the letter to some of the lords of the council and to the king, and the intelligence as to the letter was soon known to the conspirators, who, however, made no attempt to escape, and Fawkes, alone, with the extraordinary courage which he had displayed throughout the transaction, took up his station in the cellar. On Monday, the 4th of November, search was commenced, and about twelve o'clock at night Fawkes was seized as he came out of the cellar; matches and touchwood were found upon his person, a dark lantern with a lighted candle stood behind the cellar door, and under the faggots thirty-six casks of gunpowder. Fawkes at once avowed his purpose to the magistrate, nor were his courage and composure disturbed when he was examined before the king and council.

A feeble attempt was made by the other conspirators to assemble in arms in Warwickshire and Worcestershire. At Holbeach, under pretext of a hunting party, a large band had assembled, and an obstinate defence was made, in which the two Wrights, Percy, and Catesby were killed, and Rookwood and Thomas Winter wounded. The others were eventually taken. Tresham died a natural death in prison, and on the 27th January, 1606, eight persons—namely, Robert Winter, Thomas Winter, Guy Fawkes, John Grant, Ambrose Rookwood, Robert Keyes, and Thomas Bates—were tried at Westminster by a special commission, for being concerned in the gunpowder plot. Sir Everard Digby was arraigned and tried separately for the same crime. Fawkes was horribly tortured in order to make him confess more fully. All the prisoners were found guilty, and upon all the sentence of death was passed. Care was taken to render their execution, which took place on the following Thursday and Friday, as solemn and impressive as possible. Garnet, provincial or head of the Jesuits in England, was also implicated in the plot. Another Jesuit, Greenway, had told him of the plot, possibly in the confessional; and though he professed himself to have been horror-struck at the intelligence, he had faithfully kept the secret. He had not taken any part in the plot, and knew but little beyond its existence. He was, however, executed 3rd May, 1606.

GUNSHOT WOUNDS are usually injuries of a serious nature when they occur in civil life from the incautious use of fowling-pieces, while in warfare the wounds inflicted may vary in severity from a simple bruise to the tearing away of a whole limb. Wounds inflicted by bullets may have one aperture only, that of entrance, but when a bullet passes through any part the exit aperture is usually much larger than that where the bullet has entered. It has been

observed in warfare that when a man is struck by a bullet travelling at a high rate of velocity the pain caused is not at first severe, but resembles that caused by a sting or the sharp stroke of a stick. If any important part of the body or limbs has been struck, however, the injury soon causes a feeling of great prostration, and occasionally the shock thus given is sufficient to cause death although no vital part has been touched, but more generally it passes off after a few hours if the sufferer receives surgical treatment. Bullets striking against the shaft of a bone usually shatter it, but if travelling only at a low rate of momentum they are frequently deflected in their course, and they sometimes pass out of the body at a spot considerably removed from their place of entrance. When small shot are fired close to the body they frequently enter so close together as to cause a single large wound, and at a greater distance the scattered pellets may, though small in themselves, yet inflict very serious or fatal injuries. Considerable damage also may be done when neither bullets nor shot have been used, by the effects of the powder alone, or by the material used for wadding, and many actors have suffered from the latter cause when using firearms upon the stage.

The treatment of gunshot wounds resembles very much that of other wounds, and consists in the removal, where possible, of any foreign body, in protecting the injured part from the air, the allaying of inflammation, and the use of stimulating applications where the sore has become indolent. In the case of ordinary accidents it is usually necessary to check the bleeding at the outset, and this may be effected by pressing upon the severed vessel with the finger, or if it is in a limb, by fastening a handkerchief above the spot and tightening it with a stick.

GUNTER, EDMUND, was born either at the end of 1580 or the beginning of 1581, in the county of Hertford, but of a family originally from Gunter's Town, in Brecknockshire. He was appointed professor of astronomy in Gresham College, 6th March, 1619; and died on the 10th of December, 1626, about the forty-fifth year of his age. He was the first who laid down a logarithmic scale upon wood, and used it for the purposes of the draughtsman. This scale is still used, and goes by his name. *Gunter's chain*, the common chain used by surveyors for land measurements, was invented by him, and is 66 feet in length; its convenience in practice is owing to the fact that 10 square chains make an acre. The first observation of the variation of the compass is also due to Gunter.

GUN'THER, King of the Burgundians, was husband of BRUNHILD and brother of CHRIEMHILD in the great Teutonic myth. See NIBELUNGEN-LIED.

GUR'NARD (Trigla) is a genus of fishes belonging to the order ACANTHOPTERYGII and family Triglidæ. In the genus Trigla the head is mailed and angular; the operculum and shoulder-bones are armed with spines; the body is covered with very small scales; there are two distinct dorsal fins; beneath the pectorals are three detached rays; the branchiostegal membrane has seven rays; both jaws and the front of the vomer are armed with fine velvety teeth. The gurnards are fishes always remarkable for singularity of form, and often for brilliancy of colouring. The detached pectoral appendages are organs of touch as well as of locomotion. Gurnards when captured emit a curious grunting noise. This is due, according to Günther, to the escape of gas from the air-bladder through the open pneumatic duct. In the British seas seven species occur, of which the commonest are the Gray Gurnard (*Trigla gurnardus*), a silvery gray fish, more or less clouded with brown and speckled with black; the Red Gurnard (*Trigla pini*), of a bright rose-red colour; and the Sapphirine Gurnard (*Trigla hirundo*), a large and handsome fish, remarkable for the vivid green and blue hues of the inner surface of its large pectoral fins. The last two are most abundant on the western coasts. Several other rarer species are also inhabitants of the British seas. The flesh of these fishes is firm and wholesome.

The FLYING GURNARDS (Dactylopterus), belonging to the family Cataphracti or Mailed Gurnards, are distinguished by having the body completely encased in bony strongly keeled scales.

GUSTA'VIA, a genus of plants belonging to the order MYRTACEÆ. It is nearly allied to Grias (the anchovy pear), and also to Lecythis (species of which produce the Sapucaia nuts and the monkey-pots). There are eleven species, all natives of tropical America. They are trees or shrubs, with large alternate leaves and handsome magnolia-like flowers. The petals are white, with a tinge of rose colour below; the stamens in the centre numerous, with orange anthers. The fruit is a large dry berry, somewhat fleshy and fibrous. Humboldt mentions that if the fruits of *Gustavia speciosa* are eaten they cause the body to acquire a yellow hue, which lasts for a day or two. The roots of *Gustavia brasiliana* are acrid, aromatic, and bitter; the leaves are used in cases of indurated liver, and the fruits are emetic. The wood of *Gustavia urceolata* becomes fetid shortly after it is cut; it is called *bois puant* by the French settlers in Cayenne, and is used by coopers for making hoops.

GUSTAVUS I., King of Sweden, commonly called *Gustavus Vasa*, was born at Lindholm, in Upland, probably on 12th May, 1496. He came of a noble house which had been distinguished for its opposition to the Danes, and he was involved at an early age in the troubles of the period, being carried by King Christian as a hostage to Denmark in 1518. Hearing of Christian's preparations against Sweden he contrived to escape and made his way to Lubeck, and the burgomaster of that town enabled him to land in 1520 at Stenso, near Calmar, which was holding out against the Danes. Unsuccessful in his efforts to rouse the people he fled to the peasants of Smaland, and passed from them to Dalecarlia, where for a time he was compelled to work as a labourer in the fields and mines of that district. In November, 1520, Christian was crowned at Stockholm King of Sweden, and three days after his coronation he ordered the massacre of about ninety of the nobles and leading men of Sweden, among whom was the father of Gustavus. As the news of this slaughter, which obtained the name of the "Blood-bath," spread over the country the apathy of the people gave way to a stern spirit of resistance, and Gustavus soon found himself at the head of a formidable force composed chiefly of artisans and peasants. He was successful in several battles with the Danish forces, and in 1523 took Stockholm, recovering Finland shortly afterwards. At a diet held at Strengnäs, in June, 1523, he was elected King of Sweden, and as soon as peace had been concluded he set himself to better the internal condition of the country. He found demoralization and disorganization everywhere, the clergy powerful and grasping, the nobility selfish and overbearing, and the peasantry on the point of revolution. Beginning with the church he gradually introduced reform and improvement into every department of the state. He rebuilt various towns, improved the administration of the government, greatly extended the foreign trade of the nation, encouraged agriculture, made roads, bridges, and canals, founded universities, churches, and schools, and induced various learned men to remove to Sweden. Early in his reign he displayed his intention to encourage Lutheranism, which soon took deep root in the country. In 1544 a diet at Orebro changed his elective sovereignty into a hereditary one, thus making him the founder of a new dynasty. He died, after a reign of thirty-seven years, 29th September, 1560, and was succeeded by his son Eric.

GUSTAVUS ADOLPHUS, King of Sweden, was born on 9th December, 1594. He was the sixth monarch

of the dynasty of Vasa. His father, Charles, had been declared King of Sweden to the exclusion of Sigismund, the heir of the elder line of the house of Vasa. Charles died 30th October, 1611, leaving the Swedish sceptre to his son, then in his seventeenth year. As long as Charles lived Sigismund never ventured to renew his claims to the crown of Sweden; but upon his death he invaded Sweden, and laid claim to the crown for his son Ladislaus, then a minor; but Gustavus fought successfully against the Czar of Russia, the ally of Sigismund, and also against Sigismund himself, until, by the mediation of England and Holland, a peace was concluded in 1629, upon the most advantageous terms for Gustavus. He next declared war against Austria, his principal motive being to protect the oppressed German Protestants, notwithstanding that the ground of quarrel alleged in his declaration was the enmity shown to Sweden by Austria and the violation of her territories.

Gustavus landed in Pomerania on the 24th June, 1630, with not more than 15,000 men. He made himself master of the islands of Usedom and Wollin, and pressed Bogislav, the duke of Pomerania, so warmly, that he was compelled to agree to a treaty by which the town of Stettin was put in possession of the conqueror and the whole country placed at his disposal.

The army of Gustavus was reinforced by six Scottish regiments, under the command of the Duke of Hamilton, and he provided himself with money by raising a contribution of 50,000 rix-dollars in Pomerania. After several other successes he divided his force into four parts. One division, under the Duke of Lauenburg, was ordered to the relief of Magdeburg; General Banditz was sent to make an attack upon Kolberg; Horn was left with a garrison in Stettin; and Gustavus himself encamped at Ribnitz in the duchy of Mecklenburg. While lying there he received a letter written by the Emperor Ferdinand, containing proposals for peace, in which he made the most advantageous offers to the Swedish king, including the possession of Pomerania. Gustavus rejected these proposals, and continued to make himself master of the towns and fortresses of Pomerania and Mecklenburg. By the end of February, 1631, in the course of only eight months, he had already taken eighty fortified places; but the towns of Rostock and Wismar yet remained in the hands of his enemies. The emperor sent against him Field-marshal Tilly, at the head of the imperial army. The army of Gustavus pressed forward into the heart of North Germany, gaining continual victories, and on 1st August, 1631, encamped near Wittemberg, where Gustavus received Count Arnheim, the ambassador of the Elector of Saxony. A treaty was quickly concluded, by which the Saxon dominions were opened to the King of Sweden, and the whole military power of the electorate placed under his command, the elector to provide the army with ammunition and provision, and to conclude no peace with Austria without the consent of the King of Sweden. Gustavus then prepared to encounter Tilly, who had advanced against him to Eilmarschen. On the 7th September, 1631, they met on the plains of Leipzig. The force of the King of Sweden, to which the Saxon troops under Arnheim were joined, amounted to about 40,000 men; Tilly's army was somewhat more numerous. The victory was long doubtful; but at length Tilly's defeat was complete.

All Germany was now open to the Swedes, and Gustavus hastened forwards in an uninterrupted course of conquest. But the progress of the Swedish arms excited the jealousy and apprehension of the whole German population—even among the Protestants. Gustavus was also accused of having designs on the imperial crown. His allies became lukewarm, and the inhabitants everywhere viewed the Swedes with dislike. Upon the defeat of Tilly at Leipzig, and the Saxon army making itself master of Bohemia almost without opposition, Ferdinand called in Wallenstein, who drove the Saxons out of Bohemia and threatened Gustavus, who in the meantime had gained a second victory over Tilly, in which that general lost his life. Wallenstein took up a strong position in the neighbourhood of Nürnberg. In fruitless attacks upon the camp, and through hunger and disease, in the course of seventy-two days Gustavus lost 30,000 men. At length Wallenstein moved towards Saxony, and on 1st November, 1632, he offered battle to his opponent at Lutzen.

Gustavus opened the battle to the sound of music, with Luther's hymn, "Ein, feste Burg ist unser Gott." He led the attack in person, descended at the critical moment from his horse, and killed the foremost of the enemy with a lance. While heading a second attack on horseback against the enemy's cavalry, a ball struck him from behind and he fell. Duke Bernhard of Weimar, crying out to the Swedes that the king was made a prisoner, inflamed them to such a degree that nothing could resist their impetuosity, and after a frightful carnage the enemy was forced to retreat. The Swedes gained a victory, but with the loss of their king. A strong suspicion of the crime of assassination rests upon his cousin, the Duke of Saxe-Lauenburg.

Gustavus Adolphus married, in 1621, Maria Eleonora, the sister of the Duke of Mecklenburg, by whom he had one daughter, Christina, who was his successor.

GUSTAVUS III., King of Sweden, born in 1746, was the eldest son of Adolphus Frederic, duke of Holstein, who had been called to the Swedish throne in 1743. On the 12th of February, 1771, Gustavus III. succeeded to the crown on the death of his father. The country was at this time divided by two factions, the Hats and Caps, as the aristocratic adherents to the Russian or French policy respectively called themselves. Gustavus took the bold resolution of subverting both these parties with the assistance of the people. The execution of the king's plans was commenced by the insurrection of the commandant of Christianstadt, who issued a violent proclamation against the States-general. Gustavus sent Prince Charles with a powerful force ostensibly to subdue the rebel, but in reality to unite with him. On the 19th of August, 1772, the king began to follow out his plans in person. He arrested the heads of the parties and the most powerful members of the states, and publicly announced his plans for the establishment of a new constitution. The next day the magistracy of the capital took the oaths of fidelity, and the States-general were invited to assemble. Gustavus entered the assemblage in order to submit to them the proposed new constitution. His armed force was apparently sufficient to subdue every scruple of the assembly; but as the constitution only restricted and circumscribed the privileges of the nobility, and did not infringe the liberties of the citizens, it was received by the majority with real satisfaction, and confirmed by oaths and signatures. Those who had been arrested were immediately afterwards released, and the revolution was completed.

The nobility were silenced, but they nourished a secret hatred, which at length broke out in the year 1788, when they prevailed on the states to refuse the supplies while the king was engaged in a war with Russia and Denmark. In order to free himself from the ever-active intrigues of the nobles, the king, on 3rd April, 1789, caused the leaders of the opposition in the diet to be arrested, and a law to be passed by which the royal prerogatives were very considerably increased. After varying fortunes in the war, Gustavus concluded a peace on the 14th August, 1790, with his foreign enemies; but the nobility, who apprehended the loss of all their privileges, resolved upon his death. Accordingly they formed a conspiracy under the direction of Counts Horn and Ribbing and Colonel Lilienhorn; and a nobleman of the name of Ankerstroem

undertook to murder him. Ankerstroem chose a masked ball, given on the 16th of March, 1792, at Stockholm, as affording the fittest opportunity. The king was warned by some anonymous friend; but he went to the ball, and the assassin shot him through the body. The king suffered with much firmness, and died on the 29th of March. His murderer was discovered and executed, and many of the conspirators were banished from the country. Whatever may be thought of his policy, there is no doubt that he exercised a great influence on the national taste for literature and arts. He instituted or enlarged the Swedish academies for sciences, music, and painting, encouraged the national and dramatic literature, and was himself an author and a dramatist.

GUSTAVUS IV., King of Sweden, son of the preceding monarch, was born 1st November, 1778, and ascended the throne on the 29th of March, 1792. This king displayed while a prince a capricious humour and an obstinacy that bordered upon madness. He entered into a negotiation for a marriage with the granddaughter of the Empress Catharine of Russia, and the whole court were assembled in order to be present at the ratification of the marriage-treaty when he departed secretly, and married a German princess of the house of Baden. Of all the European monarchs he was the most zealous partisan of legitimacy, and he proposed, as the great object of his life, the restoration of the dethroned family of the Bourbons to the crown of France. He involved his country in indescribable difficulties, irritated all his neighbours, and even offended England, his only ally, whom he certainly could not reproach with any friendly feelings towards Napoleon. Gustavus appears to have discovered that a storm was gathering about him, and in order to avert it he endeavoured to possess himself of the funds deposited in the Bank of Sweden. At first he made an attempt to get the money by a loan of 82,000,000 Swedish rix dollars (about £12,000,000); but as the bank commissioners refused to comply with this demand, he resolved to carry his plan into effect by force.

On 29th March, 1809, he repaired to the bank, accompanied by a detachment of military, with the intention of taking possession of the money deposited there. By order of the Diet a resistance was made, and the king arrested and confined in an apartment, where he raged like a madman. The same day there appeared the decision of the Diet, by which Gustavus IV. and all his direct descendants were declared to have forfeited their right to the Swedish crown; and the Duke of Sudermania ascended the throne under the name of Charles XIII.

Gustavus left the Swedish territories. During his exile he assumed the name of Colonel Gustavson, and renounced all external observances that might remind him of his former rank. He refused the appanage which Sweden offered him, declined having any communication with his family, and obstinately rejected all assistance from them. He subsisted chiefly on the produce of his labours as an author, together with a little pension which he drew as a colonel, but was secretly assisted by his divorced wife, who contrived to help him without his knowledge. He died at St. Gall towards the end of the year 1837.

GU'TENBERG, JOHN, believed to be the inventor of the art of printing with movable types, was born at Mainz between 1393 and 1400. His father's name was Frielo Gensfleisch, his mother's Else Gutenberg, and he preferred in after-life to be called by the family name of his mother. Scarcely anything is known of his early life, but his family was expelled from Mainz in 1420, and appears to have taken refuge at Strasburg, where Gutenberg was certainly living in 1434. In 1438 he arranged a partnership with one Andrew Drilzehn and others, for the carrying out of a "secret art," which was afterwards discovered to be that of printing. In 1445 he returned to Mainz, and in 1450 he entered into partnership with a wealthy goldsmith named John Faust or Fust, who advanced the sum of 800 guilders, and took for security a mortgage on the whole of the printing apparatus. Gutenberg had already introduced his improvement of movable wooden types, and with the capital advanced by Faust he commenced to print a large folio Latin Bible, which was finished near the close of 1455. While this was in progress several smaller works were printed and issued; but the undertaking did not pay expenses, and Faust had to make a second advance of 800 guilders to keep the work going. Gutenberg had continued his experiments all through this period, and had designed and produced movable types of metal; but his assistant Peter Schöffer, who had been employed as illuminator, had also experimented in the same direction, and profiting by Gutenberg's labours managed to improve upon them very considerably. This he communicated to Faust, who gave him his daughter in marriage, arranged terms of partnership with him, and then suddenly broke with Gutenberg, demanding instant repayment of his loans, and seizing the whole stock of machinery and materials by foreclosing his mortgage. With these in his possession he continued to print with the assistance of Schöffer until 1462. Gutenberg, now advanced in life, was by this act of his partner reduced to poverty, but fortunately found a friend in one Conrad Humery, a doctor of canon law and one of the councillors of the city. Assisted by him Gutenberg continued his labours, and in 1460 printed the "Catholicon," a grammatical work in folio, and several other books, which were issued without name or date. He seems, however, to have been still followed by pecuniary difficulties, and in January, 1465, he accepted the post of civil courtier at the court of Adolf of Nassau, receiving an annual suit of livery and an allowance of corn and wine. He died 2nd February, 1468.

GUTH'ORM or **GUTHRUM,** the famous Danish foe of Alfred the Great, was one of the chief leaders in that Danish invasion of East Anglia in 868 which ended in the martyrdom of St. Edmund, the English king of the land, whom the fierce heathens bound to a tree and shot to death with arrows because he refused to abjure his faith. Guthorm assumed the crown, and divided the land among the other chiefs. In 876 Guthorm made a sudden raid upon Wessex, where Alfred the Great was king, and surprised him at Wareham in Dorsetshire. There was nothing for it but to make peace, and the Danes after some time retired into Mercia. But early in 878 they returned and harried the whole of Wessex. Alfred with a few followers hid among the morasses and woods of Somersetshire, and for the time his cause seemed lost. This is the time of the famous stories about the cakes and about Alfred going disguised as a harper into Guthorm's camp to gain intelligence of his enemy. By Easter Alfred had gathered a few men and built Athelney Fort, and had seized the famous Raven banner in a skirmish; and with the spring matters brightened so swiftly that he was able to take the offensive. A brief campaign ended in the victory at Ethandun (Edington in Berkshire), 878. Guthorm offered terms of peace, and was baptized under the name of Athelstan. By the peace of Wedmore in Somerset, the terms of which are still extant, the land was divided, the Danes taking the greater part of England—namely, all Northumbria and East Anglia, and most of Mercia—Alfred keeping the rest of Mercia and Wessex, with London. Guthorm kept his faith remarkably well; and when the Danes again troubled Wessex at the close of Alfred's life it was under a new leader who had succeeded Guthorm-Athelstan.

GUTH'RIE, THOMAS, D.D., an eminent clergyman and philanthropist, the son of an influential merchant and banker in Brechin, was born there 12th July, 1803. Guthrie's mother was an eminently devont woman, and a

person of strong religious convictions. To this may be traced much of that breadth of view in Christian action which in her son was combined with steadfast adherence to church principles. All the influences around him in early youth tended to enlist his sympathies on the side of principles which were associated with his efforts in behalf of social morality and religious life. Before going to college he was for some time under the care of a licentiate of the Church of Scotland. Under the charge of a tutor he entered, when only twelve years of age, the University of Edinburgh, where he studied for ten years. He was licensed to preach by the presbytery of Brechin in 1825. Dr. Guthrie next turned his attention to the study of medicine, and went to Paris, where he walked the hospitals for six months. On the sudden death of his brother John, Dr. Guthrie took his place in the bank, and conducted its business for behoof of his family until his nephew was able to enter on it. This varied experience throws much light upon the rare ability which Dr. Guthrie brought to bear on so many different phases of life, both by his writings and from the pulpit. But for this, his lively fancy, great power of graphic description, and broad, genial sympathies might have failed to influence men. In 1830 he was presented to the parish of Arbirlot in the presbytery of Brechin; in 1837 he was translated to Old Greyfriars Church, Edinburgh; and in 1840 St. John's Church in the same city was built mainly for him. At the disruption in 1843 he joined the party who left the Established Church. His successful efforts in raising money to build manses for the ministers of the Free Church are well known in Scotland, and his labours in behalf of ragged schools gained him the esteem and approbation of philanthropists both in this country and in America. Dr. Guthrie's principal works are—"Three Pleas for Ragged Schools," the first of which was published in 1847; "a Plea on behalf of Drunkards and against Drunkenness" (in 1850); "The Gospel in Ezekiel" (in 1855); "The City, its Sins and Sorrows" (1857); "Christ and the Inheritance of the Saints" (1858); and "Speaking to the Heart" (in 1862). These works have had an immense sale, and some portions were translated and published in France and Holland. He died at St. Leonards in Sussex, 24th February, 1873. His autobiography and a memoir by his son was published in 1875.

GUT'TÆ (Lat., drops), small conical-shaped ornaments used in the Doric order of Greek architecture under the mutules and also beneath the triglyphs. [See GREEK ARCHITECTURE.] The theory which resolves the Doric style into a stone representation of a wooden edifice considers that the *guttæ* stand for the drops which would naturally hang from the eaves (cornice) or from the ends of the roof timbers (triglyphs), after a beating rain. Whatever their origin they break the rigid Doric line in a most beautiful manner. Several examples will be found in the Plates accompanying the article referred to.

GUT'TA SERENA, the old name for AMAUROSIS.

GUT'TA-PER'CHA. This valuable substance, the name of which is the same in all languages, and which was unknown in Europe previously to the year 1843, is the inspissated juice of a tree which grows in the Malayan forests and the islands of the Eastern Archipelago. In its origin, character, and composition it is analogous to caoutchouc, but wants the peculiar elasticity of that substance; on the other hand it possesses special and distinct properties, which render it applicable to an extraordinary variety of important uses, and which, within the comparatively short time that has elapsed since its introduction into Europe, have given a remarkable development to its manufacture. The word *gutta*, in the Malay language, means a gum which exudes from a tree; and *percha* or *pertja* is the Malayan name for the particular tree from which the gum is produced.

The merit of first appreciating its value and making it known in Europe is claimed by two individuals, who seem to have endeavoured about the same time, and quite independently of each other, to bring it into public notice, namely, Dr. William Montgomerie, who was for some years surgeon to the residency at Singapore, and Sir Jose d'Almeida, who had been for many years resident in the same settlement. The valuable qualities of the substance were no sooner publicly announced than it came into general demand. A knowledge of the article gradually spread from Singapore northward as far as Penang; southward along the east coast of Sumatra to Java; eastward to Borneo, where it was found in several places.

This eager demand for the precious gum was productive of a reckless destruction of the valuable trees that produced it. Instead of simply tapping the trees, as is practised in the case of caoutchouc, the monarchs of the forest were felled. A magnificent tree was cut down, narrow strips of the bark taken off, and the milky juice collected in hollow bamboos or plantain leaves. Some idea may

Gutta-percha Tree.

be formed of the havoc made to procure the large supplies which were imported into Singapore, when it is stated that on an average not more than 30 to 40 lbs. were procured from one tree. The result was that in the course of four years 270,000 trees were felled. It was therefore apprehended that the tree, although at first sufficiently plentiful, would soon become difficult to be procured; and this would undoubtedly have been the case, had not the Gutta-percha Company, subsequently formed in England, acted with a wise precaution, and embarked a considerable capital in seeking to promote the tapping instead of the felling of the trees.

The tree from which gutta-percha is obtained is known to botanists as *Dichopsis Gutta*, belonging to the order SAPOTACEÆ. It is from 50 to 70 feet high, and from 2 to 4 feet in diameter. The wood is peculiarly soft, fibrous, and spongy, pale-coloured, and traversed by longitudinal receptacles of reservoirs filled with gum, forming ebony-black lines. The leaves are of a leathery texture, green above and covered underneath with a reddish down; they are broadest near the top, and gradually narrow down the stalk. The small inconspicuous flowers grow in clusters of

three or four in the angle where the leaf-stalk joins the branch. There are six petals and twelve stamens.

The sap coagulates in a few minutes after it is collected; but before the crude gum becomes quite hard, it is kneaded by hand into compact oblong masses. When quite pure gutta-percha is of a grayish-white, but as brought to market it is generally found of a reddish-brown hue, arising from chips of bark that fall into the sap in the act of making the incisions, and which cause the tinge.

The articles now made of gutta-percha are numerous and varied. The toughness of the material, and the facility with which it may be softened by heat, render it peculiarly apt to receive and to maintain permanently any form that may be imparted to it. Pressure in moulds, while the gutta-percha is in a warm and plastic state, is one of the most convenient modes of giving it a determinate form. Whether wet or dry its uses are confined to cold purposes, as it is very readily affected and thrown out of shape by heat. For many purposes naphtha and other inflammable liquids act as cements, and even solvents, for the gutta-percha. It resembles very tough leather, and emits a peculiar odour; its surface is, however, capable of being prepared so as to receive paint, gilding, japanning, bronzing, and other ornamental modifications. The crude substance, as brought to England, is reduced to a pulp by macerating machines, purified by water, combined with many different substances according to the purpose to which it is to be applied, and pressed into sheets or other forms by rollers; and familiar mechanical processes are then sufficient to work up this prepared material to the required forms.

Gutta-percha is used for making a variety of ornamental articles too numerous to detail, but which might, if necessary, be grouped into such headings as domestic, artistic, surgical, chemical, manufacturing, agricultural, electrical, maritime, engineering, and ornamental. Its most important surgical use is for splints and covering moist applications to retard evaporation. A splint is made by taking a rigid board of the substance cut to the desired shape, soaking it in hot water, and then bandaging it to the limb. In a few minutes the gutta-percha is found hard and modelled to the shape of the parts. But perhaps the most important use of all to which gutta-percha has been applied is the coating of underground and submarine electric telegraph wires. In the manufacture of tubes and chemical utensils for the conveyance and conservation of acids, it is also very useful. As a substitute for leather in soling and heeling boots, too, it has been much used, and can be readily applied by anyone. It lasts well, and keeps out wet.

By dissolving the raw material in a certain solvent, and carefully filtering and evaporating, Dr. Cattell, of London, has succeeded in purifying gutta-percha so perfectly that it presents the appearance of ivory.

Nearly all our present supply of gutta-percha comes from Singapore, India, and Ceylon.

(For an invaluable treatise on gutta-percha, see "Chemistry: Theoretical, Practical, and Analytical;" Mackenzie, London.

GUTTIF'ERÆ form a small order of plants, inhabiting the hotter parts of tropical countries in both the Old and the New World. Their fruit is succulent and juicy, in many cases resembling a large apple or orange. The Mangosteen (*Garcinia Mangostana*) is probably the most delicious of any known; but it has never been seen in a fresh state in Europe, for the tree will hardly exist out of its native humid, heated atmosphere in the Indian Archipelago. In general the fruit of these plants is acrid and astringent, and quite unfit for food. The most remarkable product of the order is gamboge, which is secreted by the branches of *Garcinia Hanburii*. This is the only gamboge that is introduced into Europe, but many other species of Garcinia yield gamboge which is used in their native countries. *Garcinia Morella* grows in Ceylon and Northern India, and yields a good gamboge. *Calophyllum Calaba* of the East Indies yields an astringent gum-resin called tacamahaca.

Kokum butter is an oil extracted by boiling from the seeds of *Garcinia indica*. It is used in India for the preparation of ointments, &c., but from its yellowish tinge it is not so well liked as spermaceti. If there was a sufficient supply of the fruit it would be useful in candle-making, as it yields stearic acid more easily and in a purer state than tallow and most other fats. The fruit of the butter-tree of Sierra Leone (*Pentadesma butyracea*) yields a fatty substance. The mammee apple of South America is the fruit of *Mammea americana.*

The Guttiferæ, or Clusiaceæ, as the order is sometimes called, gives its name to the Guttiferales, a cohort of the Thalamifloræ among the Polypetalæ. [See BOTANY.] The chief points of distinction from the allied orders are, unisexual or polygamous flowers, stamens generally numerous; the species are trees or shrubs with opposite or verticillate leaves, which are commonly thick and entire; there are no stipules.

GUT'TURAL (Lat. *guttur*, the throat), a term applied to sounds, letters, or syllables pronounced or formed in the throat. Of consonants, *k*, *g*, and the soft *ch* are called gutturals.

GUYA'NA. See GUIANA.

GUYENNE or **GUIENNE,** and **GASCOGNE** (Gascony), two old provinces in the south-west of France, which formed together the largest of the thirty-two military governments into which that country was divided previous to the revolution of 1792.

Gascogne, which nearly coincides with the *Aquitania* of Julius Cæsar and the *Norempopulana* of Augustus, takes its name from the Gascones or Vascones, a Spanish people who wrested it from the Franks in the beginning of the seventh century. It included the countries west of the Garonne, and is distinguished by the names of Couserans, Comminges, Bigorre, Armagnac, Condomois, Marsan, Landes, and Labour, and now forms the departments of Landes, Gers, Hautes Pyrénées, Haute Garonne, and parts of Basses Pyrénées, and Ariége, under which heads the particular features of the country are noticed. AUCH was its capital. From this province the Bay of Biscay is sometimes called the Golfe de Gascogne by the French.

Guienne lay to the north of Gascony, and extended from the Cevennes Mountains to the Bay of Biscay, including the districts of Rouergue, Quercy, Agenois, Périgord, Bazadois, and Bordelais. BORDEAUX was its capital. It now forms the departments of Gironde, Lot, Lot-et-Garonne, Dordogne, Aveyron, and part of Tarn-et-Garonne. The name is said to be a corruption of Aquitania, which designation was extended in the later divisions of Roman Gaul so as to include the districts northwards as far as the Loire. The entire government of Guienne and Gascony was sometimes spoken of under the name of Guienne.

The historical connection of Guienne and Gascony with the Plantagenet kings of England is noticed under AQUITANIA.

The Gascons, though a very simple, industrious, and sober people, are generally represented as boasting exaggerators. This notion is supposed to have originated from the circumstance that in former times the younger sons of Gascon families were compelled, in consequence of their poverty, to seek their fortunes as adventurers in other countries, where, in order to gain attentions which their circumstances generally failed to command, they were wont to speak in hyperbolical language of the great valour and wealth of their ancestors, immediate and remote. Hence the term *gasconade* came to be equivalent to a harmless, amusing, and oftentimes highly comical vaunting.

GUYON or **GUION, JEANNE MARIE BOUVIÈRES DE LA MOTHE,** a celebrated French mystic, was born at Montargis, 13th April, 1648. She was the subject of strong religious impressions during the years of her childhood, and in her youth earnestly desired to take the veil, but at the age of sixteen she yielded to the wishes of her parents and married M. Guyon, a wealthy man, but one who suffered from weak health and who was twenty-two years her senior. Her married life was not a happy one, and she was left a widow with three children in 1676. Soon after this event she settled the greater part of her property upon her children, placed her two sons under the care of guardians, and devoted herself to a life of religious contemplation and works of charity. She fixed her abode at Gex, where Bishop d'Arenthon appointed a Barnabite, Père Lacombe, to be her director. Her conversations with Lacombe served to develop the mystical doctrines he had previously received, and when he began to preach them the bishop withdrew his protection from her. Madame Guyon then commenced a course of wanderings that led her to Thonon, Turin, Grenoble, Nice, Genoa, and finally to Paris, where she arrived in 1686. Here, however, the doctrines of Quietism were under a cloud, the teachings of Molinos having been condemned by the Inquisition, and Lacombe was arrested and imprisoned in October, 1687, Madame Guyon being herself arrested in January, 1688. Released through the influence of Madame de Maintenon her teachings obtained such notoriety that a commission, consisting of Bossuet, De Noailles, and Tronson, was appointed to examine them. This inquiry led to the memorable contest between Bossuet and Fenelon, and to the reimprisonment of Madame Guyon in 1695. She was released in 1702, when she retired to Blois, devoting herself to the prosecution of works of religion, and conducting a considerable correspondence dealing with questions of piety and theology. She died in full communion with the Roman Catholic Church, 9th June, 1717.

Madame Guyon was a woman of pure life, and one possessed of an earnest and lofty spirituality, but her religious views partook largely of mysticism, and this in her writings was often incoherently and fantastically expressed. She was a voluminous writer, her works extending to forty volumes, including theology, comments on the Scriptures, works of a devotional character, and religious poetry. The best known are "Les Torrents" (published in 1683); "Poésies Spirituelles" (in 1689); "Opuscules Spirituels" (in 1704); and "Le Cantique des Cantiques interprété selon le sens mystique" (1716). Some of her hymns were translated by Cowper. Her life, published in 1720 at Cologne, is based chiefly upon an autobiography written during her imprisonment in 1688, and corrected and enlarged during the later years of her life.

GUY'S HOSPITAL, London, was built in the year 1724. The founder, Thomas Guy, was the son of a lighterman in Horsleydown, Southwark, and contrived, by a long career of industry and frugality, and by some lucky speculations in South Sea stock, to amass a large fortune, which he devoted to works of charity and benevolence, besides making ample provision for the claims of consanguinity. He followed the occupation of a bookseller, and occupied as a place of business a house situated at the angle of Lombard Street and Cornhill, long since pulled down to make way for the improvements in front of the Mansion House. He was an alderman of the city of London, and in this capacity took an active interest in its various charities, particularly in St. Thomas' and Christ's Hospital, both of which institutions he endowed liberally during his lifetime. He was also member of Parliament for the borough of Tamworth, and built and endowed numerous almshouses there for the benefit of his poorer relatives and friends. This charity is now under the management of the local magistracy. Many interesting anecdotes are related of Guy's domestic life, illustrative of his shrewdness of character, frugality, and practical benevolence. He was never married, but his relations appear, from his testamentary dispositions, to have been very numerous. For their immediate use he bequeathed £80,000, and gave their posterity a prior claim to the benefits of Christ's Hospital and the almshouses at Tamworth. But his largest bequest was the sum of £220,000 for the endowment of the hospital which bears his name, and which he lived to see erected but not occupied—his death occurring at Christmas, 1724, a few weeks before the first patients were admitted to the wards. The hospital in Guy's time consisted only of two square blocks, which still exist. These were afterwards remodelled, and additions made to them, to accommodate 400 patients. By an act of incorporation, obtained shortly after Guy's death, the management of his estate was vested in the names of fifty gentlemen, who also became perpetual governors of the hospital. The residue of the property was profitably disposed of in the purchase of estates in Lincolnshire, Essex, and Herefordshire, which now yield an annual income of upwards of £35,000. Thomas Hunt, another London merchant, residing at Petersham in Surrey, greatly improved the resources of the charity, by bequeathing, in 1829, the bulk of his property, amounting to £196,000, on condition that the governors should increase the accommodation by 100 additional beds. This has been done by the erection of a new hospital, which was completed in 1867, and which provides accommodation for rather more than 300 patients. The chapel, which is placed in the front square of the hospital, contains a fine statue of the founder in marble, representing him in the act of pointing out to a suffering female the home he had furnished for her relief. There are also memorial windows in the chapel in acknowledgment of Hunt's bequest; and the governors have recently erected a tablet to the memory of Sir Astley Cooper, who was for thirty years surgeon to the hospital. The remains of Guy, Hunt, and Cooper are placed in the vault underneath the chapel. The medical school of the hospital has long enjoyed a high reputation, on account of the distinguished names of its medical officers, among whom may be enumerated Sir Astley Cooper, Aston Key, Dr. Bright, and Dr. Addison. For some years past it has had the largest number of students enrolled of any of the metropolitan medical schools. The average yearly number of patients admitted to the hospital is 5000, while the number of out-patients, including minor accidents, poor pregnant women, and others, has been annually increasing, and has latterly averaged upwards of 70,000 persons.

GY'GES. See CANDAULES.

GYMNAS'TICS, or more properly *Gymnastic* (Gr. *gumnastikē*, from *gumnos*, naked, it being customary among the Greeks to strip themselves, wholly or in part, before engaging in bodily exercises). Gymnastic games may be said to be prehistoric; they are mentioned in the second and twenty-third books of the Iliad. The rewards given to the conquerors in these games were called *athla*, which gave origin to the word athlete, as applied to those who contended for them. Before the time of Hippocrates gymnastics were made a part of medicine, as a means of counteracting the bad effects of increasing luxury and indolence. The various exercises were gradually reduced into a complete system: public buildings called Gymnasia were erected for the purpose, and superintending officers appointed by the state.

The first gymnasia were built by the Lacedæmonians (Plato, "Nomoi," lib. i.), and after them by the Athenians. Those built by the Romans were on a more magnificent scale, and from the extensive baths which were attached to them are not unfrequently called Thermæ.

The exercises practised in the gymnasia were—dancing, wrestling, boxing, running, leaping, quoits, and hurling the

javelin or some similar instrument. Since the introduction of gunpowder science and skill have had more to do with warfare than mere strength of muscle, and consequently gymnastics went out of repute in military life, and were soon little thought of in civil life. During the present century, however, the practice has been revived, and in Prussia, Sweden, France, and England is daily gaining more attention and improvement.

In the English army recruits have to undergo daily gymnastic training for two months instead of musketry instruction, and young officers while at recruit drill the same. Weak and awkward men are kept at it for six months. As soon as they have passed all the courses of gymnastic exercises, it is left optional with them to further improve themselves by voluntary practice. The object aimed at is to harden and strengthen the trained soldier, so as to enable him to cover 1000 or more yards of ground at a rapid pace, and leave him in good wind and able to use his bayonet efficiently. A medical inspection of the recruits is made at the gymnasium once a fortnight, and of the trained soldiers once a month. The men are also measured and weighed at stated periods, in order to observe the progress made in developing muscle, height, breadth of chest, and weight. The cavalry officers and privates have to go through a course of fencing drill, and swimming is also taught at all stations where facilities for it exist.

The principle on which gymnastic exercises act is evident; their immediate effect is an increase both in the size and power of the parts exercised, in consequence of an admirable law which obtains in living bodies, that (within certain limits) in proportion to the exertion which it is required to make a part increases not only in strength and fitness, but also in size. Instances of the application of this law may be seen daily. A person is called on to engage in some new avocation in which muscular exertion is required, and every day he is not only improved in strength and dexterity, but the muscles, brought into unusual action, increase rapidly in size and vigour, so as soon to surpass those of the rest of the body which have been less employed. Nor does the beneficial influence stop here. If the exertion be not carried so far as to produce excessive fatigue, all other parts of the body sympathize with the improving condition of that which is chiefly exerted; the circulation, being excited from time to time by the exercise, acquires new vigour, and the blood being thrown with unusual force into all parts of the system, all the functions are carried on with increased activity. Improvement in the general health is soon manifested; and the mind, if at the same time judiciously cultivated, acquires strength, and is rendered more capable of prolonged exertion. As instances of the bad effects of a deficiency of exercise, it will be sufficient merely to allude to the condition of those who, being compelled to a sedentary occupation during the greater part of the day, neglect to occupy a part of their leisure time in some active exertion, such as walking, riding, &c.

Excessive exercise, on the other hand, should be carefully avoided; for, though less frequent, instances are not uncommon where undue exertion has produced effects scarcely less injurious than those which result from inactivity. The existence of either class of evils is sufficient to prove that gymnastics should form a part of the education of youth, as much as "literary instruction, music, and the art of design," which with "gymnastic" are mentioned by Aristotle ("Polit.," lib. viii.) as the four branches of instruction recognized in his day. In order that gymnastics may produce their proper results, some general system should be established in all schools, by which one sex may be preserved from the evils of deficiency, and the other from those of excess in exertion; and the beneficial influences which gymnastics exercise on the mind as well as on the body may thus be secured to both.

Gymnastics, properly so called, are simple exercises whose primary and direct aim is muscular development and health. They should commence with elementary and special movements, with a view to render every part of the body supple, and proceed to the exercises of leaping, suspension, standing and walking on beams, walking on stilts, climbing, swinging, vaulting, &c. The games that bring the greater number of muscles into successive or harmonious play are the best to strengthen the system during infancy and adolescence, and to maintain it in vigour and health during manhood. A few of the most appropriate are cricket, football, rackets, tennis, lawn tennis, golf, battledore and shuttlecock, dancing, rowing, skating, bicycle and tricycle riding, climbing, and swimming. Reading aloud and singing are also admirable agents in expanding the chest.

GYMNOCAR'POUS is a term in botany used in describing the fructification of certain fungi, such as the common peziza, and also of some lichens which, according to Schwendener, are essentially fungi. When spores are formed the threads containing them (*asci*) may remain covered by the sterile tissue, allowing the spores to escape by a pore (angiocarpous), or the asci may grow outwards, and remain free on the surface (gymnocarpous).

GYMNOC'LADUS, a genus of plants belonging to the order LEGUMINOSÆ, tribe Eucæsalpinieæ. There is but one species, *Gymnocladus canadensis* (the Kentucky coffee-tree). It is a tall, slender tree, reaching the height of 50 or 60 feet, though only 12 or 15 inches in diameter. Up to a height of 30 feet it is frequently without branches, which are large in proportion to the stem. This during the winter gives it the aspect of a dead tree, and hence the French-Canadian name Chicot (stump-tree). The leaves are 3 feet long, doubly-compound (bipinnate), which makes the tree a valuable one for planting in parks and gardens. The flowers are white, and the pods are thick and of a dark-brown colour. The wood is hard, compact, and of a fine rose colour. In America it is used in cabinetmaking and carpentry. It has the property of rapidly converting its sap-wood into heart-wood, so that the smallest trees may be applied to useful purposes. This tree grows well in Great Britain, but does not ripen its seeds. The name is derived from the circumstance that the seeds were used by the early settlers as a substitute for coffee.

GYMNOGRAM'MA is a genus of FERNS which is remarkable for containing many handsome species, and especially the original gold and silver ferns. This singular appearance is caused by the fronds being coated beneath with white or yellow powder; it occurs in one section (Ceropteris) of the genus, but is found also in other genera.

This genus is known from the veins being occupied almost entirely by the sporangia, which form linear, naked sori. *Gymnogramma calo-melanos* (beautiful black) is a fine, strong-growing species, with tripinnatifid fronds from 1 to 3 feet long, dark green above, silvery white below; the stipes and rachis are shining black. *Gymnogramma chrysophylla* (golden leaf) is considered by Hooker and Baker to be a variety only of the above. The fronds are smaller, light green above, and golden below. These are both natives of the West Indies. *Gymnogramma javanica* is a beautiful stove fern, requiring plenty of heat and moisture. The fronds spring from a creeping rhizome, and are from 1 to 4 feet long, pinnate or bipinnate. The pinnæ are light shining green with broad stripes of yellow running across. It is a native of India, Japan, Malay Archipelago, and western tropical Africa. *Gymnogramma flexuosa*, a native of tropical America, is an elegant fern; the fronds are 3 or 4 feet long, very much divided.

Hooker and Baker enumerate eighty-four species, which are chiefly found in the tropics. One species, *Gymnogramma lepto-phylla* (scale-leaf), is found as near our shores as Jersey. It is very widely distributed, extending

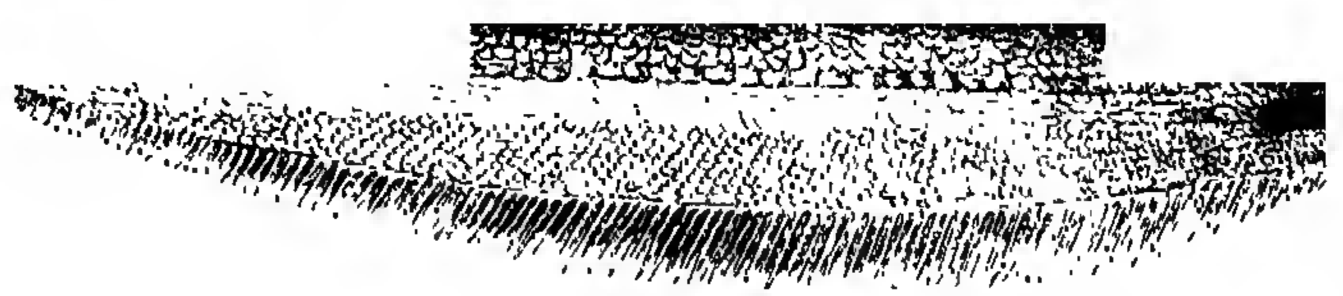
from Jersey along the Mediterranean shores to Australia, New Zealand, and tropical America. This is one of the very few annual ferns.

GYMNOS'OPHISTS (Gr. *gumnos*, naked, and *sophistēs*, a sophist), a sect of Indian philosophers frequently mentioned by the Greek writers, and so called from their habit of going almost naked. Their manners and habits were not unlike the Cynics of the Greeks, as personified by Diogenes. They were frequently consulted by the highest personages in cases of difficulty or importance, and great reliance was reposed in them. They would not, however, wait upon their inquirers, but obliged them to send their messages or to come themselves. They lived upon the natural productions of the earth without culture, and did not form themselves into societies, as other sects did; but each one had his particular place of retirement, where he studied in solitude and performed his devotions. They were very strict in their frequent examinations of their disciples or scholars, in order to ascertain the improvements they had made in the different branches of learning, or the special virtues or good deeds they had practised since the previous examination. They believed in the immortality of the soul and its migration into different bodies. The Gymnosophists are mentioned and particularly described by Diogenes Laertius. According to St. Jerome and Clemens Romanus, their great leader was one Buddas, or Butta; but Suidas classes him among the Brachmans, from whom the modern Brahmans have doubtless originated.

GYM'NOSPERMS, in botany, is the name given to that group of plants which includes the CONIFERÆ, CYCADACEÆ, and GNETACEÆ. All flowering plants are divided into the two great groups, Gymnosperms (Gr. *gymnos*, naked; *sperma*, seed) and Angiosperms (Gr. *angios*, vessel); and, as the names imply, one great difference consists in the ovules (or young seeds) being in the one case contained in a closed receptacle (or ovary), and in the other being placed in an open receptacle, such as the scale of a cone. Other differences are that the pollen-grain of gymnosperms is composed of two cells instead of one; that the endosperm is formed before fertilization, and not as a result of it; and that in the endosperm is formed "corpuscula," in which the germ-cells (embryonic vesicles) originate.

Gymnosperms form a link between the angiosperms and the higher flowerless plants (cryptogams), the corpuscula corresponding to the archegonia of the flowerless plants, and the formation of the pollen-tube to the formation of the microspores of Selaginella.

GYMNO'TIDÆ is one of the three families of fishes belonging to the suborder Apoda, of the order PHYSOSTOMI. The suborder Apoda contains fishes with an elongated serpentiform body and no ventral fins, such as are included under the general name Eels. In this family dorsal fins are absent. In the genus Sternarchus (see cut) the dorsal fin is represented by a long elastic adipose band, lying in a groove running along the back, wherein it is generally glued down by mucus. It is easily detached, and then appears as a long whip thong fixed in front. In the figure it is shown partially disengaged. In all the genera the anal fin is well developed, and edges the whole



Sharp-nosed Thong-fish (*Sternarchus oxyrhynchus*.)

under surface, commencing close behind the vent. The caudal fin is usually absent, the tail tapering away to a point. The vent is never situated further back than beneath the gills, and sometimes has a more forward position. The skeleton is in advance of that of the true eels, forming the family Murænidæ, the humeral arch being attached to the skull. The Gymnotidæ also possess perfect ventral ribs. The air-bladder is double. The eggs of the Gymnotidæ are contained in ovarian sacs, and do not drop into the common cavity of the abdomen, as in the case of the Murænidæ. The stomach has a cæcal projection, and there is a papilla behind the vent. Teeth are present on the upper jaw and mandible in some species, but wanting in others, and none exist on the vomer. In some genera the faces of the fish are elongated and tubular, with small terminal mouths; in others the jaws are abbreviated and the gape wider.

The Gymnotidæ are all fresh-water fishes from the rivers of tropical America. There are five genera, Gymnotus, Sternarchus, Rhamphichthys, Sternopygus, and Carapus. Gymnotus contains the ELECTRIC EEL, the most powerful of electric fishes. Sternarchus is remarkable for the rudimentary dorsal fin noticed above, and the presence of a small caudal fin. The species figured, *Sternarchus oxyrhynchus*, from the river Essequibo, has the snout produced into a long tube.

GYMNO'TUS. See ELECTRIC EEL.

GYMNU'RA. See BULAU.

GYNŒ'CIUM, in botany, is a name given to the portion of the flower which contains the ovules (or unfertilized seeds), together with the portion adapted to the reception of the pollen.

GYP, a man-servant in a college at the University of Cambridge, the corresponding term at Oxford being *scout*. One gyp attends upon a certain number of students. The gyps form a very peculiar class, highly characteristic of university life. The origin of the word is lost in antiquity. The favourite etymology is from the Greek *gyps*, a vulture; for, say his young masters, he preys upon us like a vulture. The various means of profit lying to the hand of the dexterous gyp are evident, since he does all the errands and makes most of the purchases required by the students.

GYPA'ETUS. See LAMMERGEIER.

GYPOGE'RANUS. See SECRETARY-BIRD.

GYP'SIES or **GIPSIES**, a word corrupted from Egyptians, is the name given in England to a wandering race of people who are found scattered over most of the countries of Europe, parts of Asia and Africa, the United States, Brazil, and in smaller numbers in the various British colonies. The date of their first appearance in Europe is very uncertain, but they are described in a work written by an Austrian monk about 1122 as a people well known in Austria at that time. They do not appear, however, to have reached the countries of Western Europe before the early part of the fifteenth century, when wandering troops seem to have visited Germany, Switzerland, Italy, and France between the years 1417 and 1433. The first comers were well provided with money, bore letters of safe-conduct from the Emperor Sigismund, and professed to be travelling for a period of seven years by way of penance in expiation of their apostacy from the Christian faith. It is generally supposed that these parties were really spies sent out by the gypsy communities of Austria and Hungary to examine the condition of the countries through which they passed,

and to note what inducements were offered to more extensive migrations. It is certain that soon after this period wandering tribes of gypsies were to be found in all the countries mentioned, and by the beginning of the next century they had reached Sweden and Great Britain. Like their successors of more modern times, they practised the occupations of copper and iron smithing, the making of horse-shoes, and dealing in horses. They were also good musicians and dancers, while the women practised peddling and fortune-telling. They soon gained a bad character on account of the real crimes of cheating, pilfering, and horse-stealing, and also from the imaginary offences included under the title of "traffic with the devil." Very soon edicts of tremendous severity were issued by most of the European states against them, and the gypsies were ordered to leave the various countries under the penalties of whipping, branding, and the punishment of death. Such laws are to be found in the statutes of Germany, Spain, France, England, and Scotland, and large numbers of the gypsies were cruelly tortured and put to death. In some parts of the Continent they were accused of cannibalism, and wild confessions extorted under severe torture were made the excuse for wholesale executions. Many of these laws remained in force until the latter part of the eighteenth century, but though unrepealed, they had practically either given way to milder measures or had passed altogether into disuse.

With respect to the present numbers of the gypsies it is very difficult to arrive at any accurate estimate. The official statistics published are hardly to be relied on in the countries of Europe, and it is impossible to arrive at any general reckoning for other countries. They are found in the largest numbers in Turkey, Roumania, and Hungary, these three countries being supposed to have now about 600,000 between them, while there are believed to be about 200,000 more scattered throughout the other countries of Europe, Spain having about 40,000, and England and Scotland about 18,000. They are very numerous in Egypt, and also in Persia and Armenia, but in these countries, as in Europe, they are everywhere regarded as strangers.

The gypsies call themselves Romany and Zincali, and speak of the peoples among whom they dwell as Gentiles. They have no traditions of their own as to their origin, and they have been variously identified with the Egyptians, Mongolians, Nubians, and Bohemians; but it is now tolerably certain that they migrated originally from India, but the part from which they came and the time of their migration are alike unknown. A very probable supposition is that they started on their original journey at the time of the great Mohammedan invasion of Timur Beg, and that in their own country they belonged to one of the lowest castes, which resemble them in their appearance and habits. Their language has been conclusively proved to be a dialect of India, but in its present form it shows not only traces of Persian and Armenian influence, countries through which they have passed on their road to Europe, but also of every other country in which they have sojourned. It is almost entirely confined to speech, as they have no literature worthy of the name, but they possess a number of ballads and songs in the Romany dialect, and they have also a large number of folk tales, resembling those of other Aryan races. They seem to have no religion of their own in the ordinary acceptation of the term, but they readily adopt the outward forms of the people among whom they live. Some investigators have believed they were able to find in their ideas and customs traces of a primitive worship including in its observances the adoration of the serpent, the moon, and of certain phallic symbols, together with conceptions of Christian and Mohammedan origin. Other inquirers have denied that the gypsies have any religion at all. Everywhere they exhibit the same roving habits, a dislike to a fixed settlement and to husbandry, uncleanness in their food, ignorance and intellectual apathy, a disposition to pilfer and to impose on the credulity of others. They certainly despise the peoples among whom they dwell, and consider the Gorgios or the Gentiles as enemies whom it is quite lawful to cheat if it can be done safely. They are generally of a quick and passionate temper, and very ready to resent a wrong; but, on the other hand, they are ready to forgive when reparation is offered or reconciliation sought. Among themselves they are remarkable for strong family affection, courtesy, faithfulness to each other, and generosity to such as are poorer than themselves. Further, it has been repeatedly proved that where they have been treated with courtesy and consideration, where they have been received with open confidence, they have been quick to respond and honourable in carrying out their engagements.

In appearance they are usually of middle stature, being well proportioned and possessed of considerable strength and endurance. They are also capable of sustaining great fatigue, and pay but little attention to the weather. They have tawny skins, slightly projecting cheek bones, black hair and eyes, white teeth, and small hands and feet. The women are often singularly beautiful when young, but their mode of life causes them to age prematurely. In Great Britain they are fast losing many of their distinctive characteristics. The increased cultivation of the land, and the changes in the customs of rural districts brought about by railways, have greatly diminished their opportunities for wandering. Many of them are now found regularly settled in the towns, and they have mingled to so great an extent with others that gypsies of pure blood are comparatively few in number, and this number is becoming less every year.

The chief work on the gipsy language is that of Professor A. F. Pott, entitled "Die Zigeuner in Europa und Asien" (two vols., Halle, 1844–47). For information respecting English gypsies the "Dialect of the English Gypsies," by B. Smart and H. T. Crofton (London, 1875), and the works of Charles G. Leland—viz., "English Gypsies and their Language" (London, 1873), and "The Gypsies" (London, 1882)—may be consulted with advantage.

GYRA'TION, CENTRE OF. When a system of heavy bodies, or any system possessing weight, has a fixed axis of revolution, the centre of gyration is a point at any such distance from the axis that the moment of inertia would not be altered if the whole mass were collected at that point.

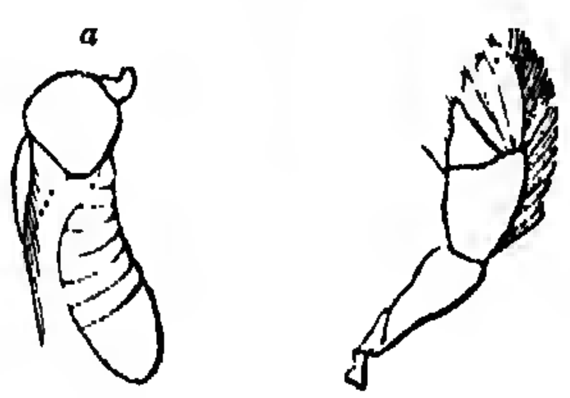
GYR'FALCON or **JER'FALCON** is the name given to a group of large FALCONS inhabiting high latitudes. This group contains five species; it is sometimes separated from the genus Falco under the name Hierofalco. The Norway Gyrfalcon (*Falco gyrfalco*) is a native of Scandinavia, occurring also in Northern Asia. This gyrfalcon measures from 20 to 23 inches in length. Its plumage is of a white colour, while the whole of the back is marked with grayish-brown spots; the bill is bluish, the cere and feet yellow, and the claws black, exceedingly sharp, and much curved. The young birds are brown, and the white colour gradually encroaches upon this at each moult, until in the adults the whole brown surface becomes pure white, while the feathers of the back and wings retain the spots above mentioned.

The Greenland Gyrfalcon (*Falco candicans*) is a native of Greenland and Polar North America, occurring occasionally during migration in Britain. The adult plumage is nearly pure white; the bill and cere is of a light yellow colour. According to Sir J. Richardson, in the Hudson Bay Territory its habitual prey is the ptarmigan, but it also destroys plovers, ducks, and geese. The nest is built on rocks, and is composed of sticks, seaweeds, and mosses. It is remarkable for great strength and courage. The Iceland Gyrfalcon (*Falco islandicus*) inhabits Iceland and

Southern Greenland, occurring rarely in the British Isles. In the days of FALCONRY this gyrfalcon was highly prized on account of its rarity, as well as on account of its strength and courage and the swiftness and boldness of its flight. The other species of gyrfalcon are Holboll's Gyrfalcon (*Falco holbolli*) and the Labrador Gyrfalcon (*Falco labradorus*).

GYRIN'IDÆ is a family of water beetles, finding their nearest allies in the DYTICIDÆ. The common English name for these beetles is whirligigs; they are so called from their habit of swimming in circles on the surface of the water; and the velocity with which they execute their evolutions is really surprising. The French have given them the name of tourniquets.

The Gyrinidæ agree in general form and habits with the Dyticidæ. The hinder legs of the whirligig beetles are, however, very short and broad, forming wonderfully efficient paddles. These limbs are much compressed; the joints of the tarsus form when expanded a thin semicircular disc. The anterior pair of legs are long. The antennæ are very short. Each eye is divided into two, by horny processes, so as to give the appearance of four eyes, one pair directed upwards, the other downwards. In diving the whirligigs



a Antenna. *b* Hind leg of a species of Gyrinus.

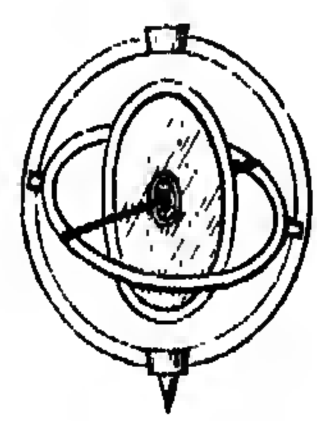
carry with them a large air-bubble. The eggs are deposited on the leaves of aquatic plants. The larvæ are aquatic. The species, though not numerous, are widely distributed. One species, *Gyrinus natator*, a little black insect, is very common in Britain.

GYROCAR'PUS, a genus of plants containing only one species, *Gyrocarpus asiaticus*, widely distributed in the tropics of Asia and America. It grows to be a large tree, with cordate leaves, which fall about the end of the rainy season; after which the flowers make their appearance in the cold weather, but are shortly followed by the new leaves. The wood of this tree is whitish-coloured and very light. It is preferred whenever procurable for making the catamarans, or rafts, on which the natives come off to ships through the heavy surf of the Madras coast. It is also used for making toys, and takes paint and varnish well. This genus belongs to the order COMBRETACEÆ.

GY'ROSCOPE. This remarkable instrument depends for its working upon the permanency of the direction of the axis of a rotating body. A hoop, a rifle bullet, a top, are instances of this axial permanency, especially the last, and the gyroscope is a sort of top.

The central part of the gyroscope is a heavy disc or fly-wheel through which a spindle passes; the ends of this spindle rest in a ring, so that the disc is suspended perpendicularly in the ring, and if a cord be wound round the spindle the disc can be rapidly rotated top-fashion. The ring is furnished with two knife edges resting in depressions cut to receive them in a circular frame, and these knife edges are in a line at right angles to the axis of the disc.

Now here we have a body (the disc) rapidly rotating round an axis (the spindle), and not disturbed by gravity, for the outer frame is suspended by a fine wire and also rests upon a pivot. The centre of the disc, too, is the centre of gravity of the whole apparatus, which therefore has all the elements of permanence. The disc being very rapidly rotated, and its ring being then set in the frame upon its knife edges, the frame having been so arranged that the axis (the spindle) is in the line with any fixed star, the remarkable result follows from the law of the permanence of an axis of rotation, that the axis of the gyroscope continues to point to that star so long as the



The Gyroscope.

gyroscope disc continues rapidly to rotate, an affair of accurate pivoting and good lubrication. But the earth is turning all the time in its daily rotation; therefore the axis of the gyroscope, which is really of course permanent, appears to turn from east to west. The stars also appear to turn, and for the same reason—namely, the rotation of the earth—in the opposite direction to their apparent movement.

In this beautiful manner did FOUCAULT in 1851 demonstrate the rotation of the earth. Watching the gyroscope axis in its slow revolution we actually see the earth turn before our eyes, so to speak. If a gyroscope be made to turn for twenty-four hours its axis performs a complete revolution. This was first accomplished by Mr. G. M. Hopkins, an American, in 1878, with the help of electro-magnetic motors. But even without electricity enough duration of movement can be obtained to clearly show the astonishing effect above described. The vividness of the demonstration upon the mind is excelled only by the kindred pendulum experiment. See PENDULUM.

H

H is the surd aspiration of the guttural series, and is a faint pronunciation of the true aspirate sound, which in German is denoted by *ch*. In our oldest English, *h*, even in the middle of a word, had this guttural sound. Thus, *liht* was pronounced *licht*, as it still is in the north, and it was not until the pronunciation became weakened that *c* or *g* was put before the *h*, as *licht* or *light*, to reinforce it. But the *gh* is now in the south of England quite mute in the middle of the word. This decay of the guttural sound of *h* made the Old English words *hwi*, *hwat*, &c., sound almost like *wy*, *wat*, &c., and an alteration of spelling consequently took place, *hwi*, *hwat*, &c., becoming *why*, *what*, &c. The sound is still retained before the *w* in Scotland, but transformed into a labial aspirate, and this is very much softened in most parts of England, and altogether dropped in the remainder in favour of the bare *wy*, *wat*, &c. The final *h* in Old English, of course originally palatal (or guttural) like the rest, as in the words *burh*, &c., has become *gh*, as *burgh* or *borough*, &c.; and this *gh* or *ugh*, by a further modification of time, sounds sometimes as *u* or *w*, as in *plough*, *through* (for *ploh*, *thurh*), sometimes as *f*, as in *enough*, *rough*, for *genoh*, *ruh*. In the earliest alphabets, as the Greek and Hebrew, the symbol whence the modern character is derived denoted the syllable *che* or *he*. Hence the Hebrew name was *cheth* or *heth*; and the Greek probably at first *heta*, as it was afterwards *eta*. As the guttural sound disappeared in the latter language, the letter finally denoted the simple vowel *ē*, and the first half of the old vowel sign, ⊢, became ' (the rough breathing), while the second half, ⊣, became ' (the smooth breathing). In the Latin alphabet it was retained as the symbol of the aspirate. The English name *aitch* was probably at first *ech*, with the vowel prefixed, as in *ef*, *el*, &c. The guttural sound of *ch* is often confounded with the sibilant *ch*, as heard in *church*. The character H is most ancient. It comes to us from the Phœnicians, who had it from the hieroglyphics of Egypt; and it was at first a picture of a sieve, now dimly presented in the cross line of the letter. The Phœnician *cheth* had the shape 𐤇, the same as in early Greek inscriptions.

The letter *h* is liable to the following changes in different dialects:—

1. *H* is interchangeable with *c*. To the examples given in the article C may be added the Latin *decem* compared with the German *zehen*.

2. *H* is interchangeable with *ch*. Thus the Greek forms *cheimōn*, *cheimerinos*, *chamai*, are severally connected with the Latin *hiems*, *hibernus*, *humi*, but these may have been originally rough, as *chiens*, &c. See the remarks above. In like manner, as above indicated, it becomes *g* or *gh*, and *vice versâ*. Examples: the German *fliehen*, *sehen*, compared with the English substantives *flight*, *sight*, or these with the Old English *fliht*, *siht*. On the other hand it has hardened into *k* in the Scotch word *ilk* for Old English *cohl*. We have both the *k* and the *h* in the form of a palatal or sibilant *ch* in such words as *candle* and *chandler*, *cattle* and *chattel*.

3. *H* with *s*. Compare the Latin *sub*, *sex*, *septem*, *sus*, with the Greek *hupo*, *hex*, *hepta*, *hus*.

4. *H* with *f*. Hence the Latin words *hostis*, *hostia*, says Festus, were sometimes written *fostis*, *fostia*. The French word *hors* is derived from the Latin *foris*. The Spanish language abounds in examples of this change, as in *hermoso*, from the Latin *formoso*; the Portuguese retains the form *formoso*.

5. *H* with *w*. Many Greek words which had originally the digamma (another name for the letter *w*) at the beginning, took a mere aspiration afterwards. In English the word *who* has nearly exchanged the *w* for what is sounded as an *h*; and the relative adverb *how* is no doubt derived from the relative itself.

6. When any consonant or consonants in the middle of words had nearly lost all sound, the letter *h* appears to have been employed as a representative of the vanishing sound. Hence in Latin *mihi*, for what would appear by analogy to have been once *mibi*; and in German *stehen* and *gehen*, for what must have been *standen* and *gangen*.

7. The letter *h* is often dropped altogether in pronunciation, and hence in writing also. In Latin many words are written indifferently with or without an *h*, as *arena*, *harena*; *onustus*, *honustus*. The Italians for the most part are averse to all aspirates, but the people of Tuscany still maintain their ancient character for the strongest pronunciation of these harsh sounds.

8. *H* has disappeared from before many English words, especially before *l*, *n*, *r*; as *it*, *loaf*, *ring*, for Old English *hit*, *hlaf*, *hring*, &c. It has been thrust into *wharf*, *whelm*, &c., but it has fallen out from *taher*, *feoh*, now written as *tear*, *fee*, &c.

H as a numeral in old Latin inscriptions denotes 200, and with a line above the H it denotes 200,000.

H, in music, is used only in Germany, where it stands for the note we call B, the German B being our B♭. Thus the great Bach was able to write figures upon his own name (B♭, A, C, B♮). It is pronounced *Ha*. The reason for the use of H for B is given in ACCIDENTALS. H *moll* (B minor) is a favourite key with some German composers.

HAAR'LEM, HAERLEM, or **HARLEM,** a city in the Dutch province of North Holland, stands on the Spaaren, which runs from the Lake of Haarlem into the Y, 4 miles from the shore of the North Sea, and in 1883 had 42,083 inhabitants. It is connected by canals with all the chief towns in Holland, and by railway with Amsterdam and Leyden, from which it is respectively 12 and 13 miles distant. Haarlem is famous for its resistance to the Spaniards in 1572, and for the cruel treatment of its citizens by the son of the Duke of Alva after their surrender. The town is well built; the streets are clean, planted with trees, and traversed by numerous canals. It contains several Roman Catholic churches, of which the Cathedral of St. Bavon, built in the fifteenth century, is one of the largest churches in Holland, and is celebrated for its great organ, which has 5000 pipes, sixty stops, and four rows of keys, and was for a long time the largest in the world. There are also Calvinistic and Lutheran churches. The finest building in the town is the Stadhuis, or town-house, which stands on one side of the market-place. The Prinzenhof, in which the states-general of Holland formerly met, is now converted into a museum of arts antiquities, medals, and pictures. The public walks on the site of the ancient ramparts are exceedingly agreeable. Haarlem, besides many benevolent institutions, has numerous public schools, an academy of sciences, a botanic garden, a public library, a national normal school for schoolmasters, and the Teyler Institution, which comprehends an establishment for the poor, a society of natural

history, valuable collections, and an observatory. The library boasts of the early productions of Laurence Coster, a native of this town, for whom the Dutch claim the invention of the art of printing. [See COSTER.] The neighbourhood of the town is studded with handsome country seats, and laid out in gardens. In the southern suburb of Haarlem are the famous nursery flower-gardens, in which are raised the flowers and flower-seeds which form such important articles of Dutch commerce. Haarlem is the centre of the trade. They consist principally of hyacinths, tulips, and other bulbs. There are extensive bleaching establishments here, which formerly supplied large quantities of linen to England, whence the article came to get the name of *Holland*, as coming from that country. Silk, carpets, ribbons, lace, and soap are among the principal manufactures.

The large lake called Haarlemer Zee was drained in 1853-54, and there is now only a small stream of water meandering through the rich land once covered by its waters.

HAB'AKKUK, one of the minor Hebrew prophets, and the eighth on the list in the Massoretic text. The prophet is the only person mentioned in the Old Testament as having this name, the meaning of which is rather uncertain. Nothing is known as to his history, as Scripture is silent upon it, and the rabbinical traditions that exist are untrustworthy and mythical. Nor can the time during which he prophesied be determined, and it is variously assigned by modern critics to the periods covered by the reigns of Manasseh, of Josiah, and of Jehoiakim. Dr. Davidson assigns the book to the reign of Josiah, which lasted from 641 to 610 B.C.

The book of the prophet may be divided into two parts, the former of which is termed the "burden which Habakkuk the prophet did see," extending to the end of the second chapter, and the latter entitled "a prayer of Habakkuk the prophet," which extends to the end of the book. The opening portion consists of a dialogue between Jehovah and the prophet, in which the latter bewails the evil state of the times and receives a warning of the coming invasion of the Chaldeans as a punishment for the iniquity of the people. The prophet then appeals to the justice and pity of Jehovah against the pride and cruelty of these invaders, and receives a reply in which they are threatened with destruction. Against the enemies of the people of the Lord a fivefold woe is pronounced, and this section concludes by asserting the majesty of Jehovah. The second portion of the book consists of a hymn of praise, in which the writer dwells with exultation upon the power and majesty of God, and declares his unshaken trust in the divine power and love. This portion of the prophecy is styled by Ewald "Habakkuk's Pindaric ode," and is universally admitted to be one of the finest specimens of Hebrew poetry. The whole book is marked by purity of language, grandeur and sublimity of conception, a peculiar richness of imagery, great vigour of expression, and high poetic skill. Its canonical authority has never been disputed, and it is quoted several times in the New Testament.

HA'BEAS COR'PUS is a writ at the common law used for various purposes. It derives its name, like other writs, from the formal words contained in it. When the writ of Habeas Corpus is spoken of without further explanation, it always means the important writ which will presently be described; but it is also used for certain purposes in the courts of common law, as for removing prisoners from one court into another, and for compelling the attendance of prisoners as witnesses, &c. But the great writ of Habeas Corpus is that which, in cases of alleged illegal confinement, is directed to the person who detains another; and the purport of the writ is a command to such person to produce the body of the prisoner, and to state the day and the cause of his caption and detention, and further to do, submit to, and receive (*ad faciendum, subjiciendum, et recipiendum*) whatsoever the judge or court that awards the writ shall direct.

It is issued out of any of the superior courts, both in term and vacation, and runs into any part of England and Wales and the Channel Islands, and also to Ireland, its place in Scotland being taken by the Wrongous Imprisonment Act of 1701, c. 6. Up to 1861 the provisions of the Habeas Corpus Act extended to all foreign and colonial dominions of the crown, but by the Act 25 & 26 Vict. c. 20, it was enacted that "no writ of Habeas Corpus shall issue out of England by authority of any judge or court of justice therein, into any colony or foreign dominion of the crown where her Majesty has a lawfully established court or courts of justice having authority to grant and issue the said writ, and to insure the due execution thereof throughout such colony or dominion."

Any prisoner may move for his Habeas Corpus, and it may also be used for the purpose of removing any unjust restraint of personal freedom in private life when imposed by a husband, a father, or any other person. All persons, whether natives or aliens, are entitled to this writ.

The statute 31 Car. II. c. 2, which is called the Habeas Corpus Act, declares the cases and mode in which this writ may be obtained; and lest this statute should be evaded by demanding unreasonable bail or sureties for the prisoner's appearance, it is declared by the 1 Will. & Mary, stat. ii. c. 2, that excessive bail shall not be required. The provisions of the 31 Car. II. c. 2 are extended to Ireland by the Irish Act, 21 & 22 Geo. III. c. 11.

It has been customary in times of alleged danger to suspend the Habeas Corpus Act. A suspension is effected by an Act of Parliament, which empowers the crown, for a limited period, to imprison suspected persons without stating any reason for the imprisonment, as was the case in Ireland in 1866-69. "The effect of a suspension is not in itself to enable anyone 'to imprison suspected persons without giving any reason for so doing.' But it prevents persons who are committed upon certain charges from being bailed, tried, or discharged for the time of the suspension, except under the provisions of the suspending Act, leaving, however, to the magistrate or person committing all the responsibility attending an illegal imprisonment. It is very common, therefore, to pass Acts of Indemnity subsequently for the protection of those who either could not defend themselves without making improper disclosures of the information on which they acted, or who have done acts not strictly defensible at law, though justified by the necessity of the moment. See 57 Geo. III. c. 3 and c. 55 for instances of Suspending Acts, and 58 Geo. II. c. 6 for one of an Indemnifying Act."

The 56 Geo. III. c. 100, which was passed "for more effectually securing the liberty of the subject," after reciting that the existing Acts only apply to cases of imprisonment on criminal charges, enacts that if any person is imprisoned, except for crime or debt, any baron of the exchequer, as well as any judge of either bench in England or Ireland, shall, on complaint on behalf of the party confined, if reasonable cause appear to them, award in vacation time a writ of Habeas Corpus, returnable immediately before the judge awarding the same, or any other judge of the same court.

The statute 31 Car. II. c. 2 introduced no new principle into the English law. From the date of the Great Charter at least, if a man was confined in prison on a criminal charge, he could apply to the court of King's Bench for the writ of Habeas Corpus *ad subjiciendum*. This writ could not be refused. The object of the statute of Charles was to prevent the abuses which had grown up to the detriment of this important privilege.

The Act of Habeas Corpus, as said above, does not run in Scotland, but the same results are more effectually attained by the Act of 1701, c. 6.

HABIT is the term for an action or a series of voluntary actions performed without definite volition, differing thus from reflex actions, which are entirely involuntary. Habit may, however, be so confirmed as to come to have quite an automatic or reflex character. Considering the physiological side first, it appears that just as the higher reflex actions occur without any reference at all to the brain proper (the cerebral hemispheres), so habitual actions, if very firmly acquired, are ordered by the great ganglia at the base of the brain. It is, indeed, a matter within everyone's observation that to endeavour to assist a habitual action by thought is quite ineffectual; persons repeating poetry or playing music by memory, if they break down find it far better to try back along the usual train of action, repeating the previous phrases, &c., and trusting to habit to carry them over the gaps, than to exert the powers of memory or reasoning.

The first element of habit is a great readiness of performance of some particular action, begotten of continual performance of it. The second is the association of this action with some external stimulus; so that the action being already perfectly easy, the stimulus will readily suffice to call it forth. Repetitions of the stimulus until the action follows instantaneously, and without conscious volition, give the simplest form of habit. Examples are the soldier's movements at drill, &c.

From such simple cases the complex cases are built up. A series of such actions, forming a train of connected movement, are so interwoven by the operation of the mental law of the ASSOCIATION OF IDEAS that a stimulus which sets the train going is sufficient to cause it to operate in its entirety. And as was said before, when once this habit of associated actions is established conscious thought is actually a hindrance. The violinist who thinks how his bow is moving at once begins to play falsely, and perhaps there is no more beautifully complex series of movements than those of a violinist's bow, arm, and wrist. Again the tight-rope dancer who stops to think about her balance will probably fall. It is a matter of everyone's knowledge that if a man goes upstairs in his own house in the dark the feet find the way quite securely, passing the landings and turning the corners, unless he begins to think about it. If that occurs the matter turns difficult at once, and the climber gropes and stumbles the rest of the way. Walking, swimming, dancing, easy enough by habit, are very difficult when they have to be thought out. The familiar case of learning to walk after recovery from illness illustrates this completely. So firmly at last do these habitual trains of movement become linked together that a skilled musician can play an oft-repeated exercise, or brilliant piece, or dance tune (anything not requiring expression, that is, *thought* and *feeling*), and hold a conversation at the same time; and a man can read a book while walking along a difficult path or a crowded street if they are very familiar to him.

In point of fact it is not too great a stretch of language to say that nine men out of ten become creatures of habit. Who has not seen the fatal effects of the retirement of the active man of business, who for tens of years together has gone by the same train to the same office, pored over the same books, worked among the same clerks, and returned at the same hour, until having made a competency, in some unlucky moment he resolves to retire? All his springs of action have been taken away, and in far too many cases he is too old to seek out new modes of life; and so he drags wearily along to the end, wondering why, now that his life's aim has been successfully accomplished, he is unable to enjoy his victory.

This brings us to another point. In youth habits are easily formed, and are also, we may thankfully add, not impossible to be broken; but in older life the nerve-tracks are hard to disturb, the currents of thought have ploughed their channels; old connections hang together indissolubly, new connections can hardly be made, for the material is no longer plastic. Often, too, a new habit necessitates the eradication of an old one at the same time to make way for it, and this not only doubles, it increases by twentyfold the difficulty for older persons. Persons who feel themselves growing to be the slaves of a bad habit should read of Coleridge's trouble with opium-eating, or should read the actual confessions, harrowing but deeply interesting, of his friend De Quincey ("Confessions of an Opium-eater"). The comparative ease with which a youth of vigorous will can give up smoking or drinking intoxicating liquors, &c., is very remarkable compared with the difficulty felt by his seniors in the same efforts. So also the ready acquirement of the habit of early rising by children (if indeed it be not natural to them, as it usually is) contrasts painfully with the inability to wake except at the accustomed hour of those who are older, and who perhaps would give much to be able to acquire that habit.

It follows therefore that the task of the educator and of the parent is a very important one as to the control of the habits of children. To encourage them in good habits and to check them in evil habits is not only to train them well, but to use a wise economy; for an action performed by habit costs the brain no effort, and the available brain-force remains fresh for real work. The brain-force which ill-trained boys spend over the effort to fix the attention on their lessons is force for the well-trained boy to apply to learning the lesson itself, since his attention, by long habit, fixes itself at the proper time without any effort of his. It becomes, then, of the highest importance to specify the conditions of acquiring or of eradicating a habit.

Habit is acquired, according to the psychology of it given above, by first of all gaining perfection and ease in the voluntary and conscious performance of the action. We thus acquire the first element of simple habit, as when we teach a child to perform the actions of walking while its body is supported, or as when, in order to learn by heart a piece of music (to take a case of a complex habit), we first get absolutely perfect in playing it from notes. When the action desired to be converted into a habit is thus made easy, we take the second step towards a habit by constant repetition; repetition continued until the legs walk as of themselves, or the violin bow travels in one long sweep, or the piece of music plays itself, so to speak, almost unconsciously. But we must at the same time, for a long while in the early stages of habit, refuse to *allow* the action to become spontaneous, lest it be wrongly learned, for an erroneous habit is far more difficult to unlearn than a true habit is to acquire; therefore a third element in the formation of habit is careful watching over the early stages of the constant repetition to ensure absolute and unvarying correctness. And the final condition is the unfailing recurrence of the action at its proper time. To make this clear we might say roughly that it takes ten performances (or twenty or thirty it may be) to overcome the effect of a single omission in early stages. Perhaps the greatest fault of parents with their children is the neglect of attending to this fact. Say it is the finishing of lessons before play begins, for instance; a wise parent will never, on any occasion, give way on such a matter, because he knows that but a few infractions of the rule, and these at comparatively wide intervals, will suffice to check the growing habit, which on the other hand will one day prove invaluable, if only it is allowed to firmly establish itself. It must be noted that, for two reasons—(1) plasticity of the mind, and (2) absence of distracting thoughts and cares—far less repetition is necessary to enable a child to acquire a firm habit than is required in the case of an adult.

Habit is properly an affair of action, but it extends largely into thought. The habits of speaking the truth, of facing opposition when one feels in the right, or of

promptly and gracefully yielding when one is in the wrong, and in fact the operations of "character" in general, are largely composed of mental elements, though, as with most habits, they eventuate in action. In fact there is such a thing as the habit of striking a certain mental attitude. One can cultivate the habit of readiness to consider a new view, or that of resistance to all things fresh, in just the same way and by the same four conditions as one can cultivate bodily habits. Even the habit of cheerfulness may be effectually obtained with care, and who does not know how quickly the habit of gloominess or of carping criticism, of seeing the worst side of things in fact, grows up in a neglected and ill-ordered mind, like foul weeds in a sun-sweltered marsh.

Habit is eradicated by the converse process. First, at any cost, however great, we must break the habit; then break it again at an early time; then continue to diminish the intervals, until the habit, though by great and continued force of will, is fully broken. Secondly, we have to guard with the entire strength of character against a single relapse beyond what has already been planned in the early stages, against any relapse at all in the final stages; one relapse will neutralize the effect of a hundred successful attacks, it may be. Thirdly, we must watch, even when the chain begins to hang loosely, to make sure that on each occasion the habit has been actually and completely broken through; and lastly, we have simply to keep on, and on, and on, until the habit finds its old place so firmly occupied by other thoughts and actions that the door is barred against it for ever. It is sufficiently difficult for the young, but it is a terribly hard, and long, and wearisome task for the mature; but when it is once performed, he who has gone through it, though it may be he is a sadder man, is commonly a wiser and a better man than his fellows.

The function exercised by a settled good habit has not inaptly been compared to that which a fly-wheel exercises over the action of machinery; it lends steadiness and equilibrium to the various motions, it serves to quicken action in times of lethargy and depression, and to moderate it at periods of excitement and enthusiasm. On the importance of good habits it is indeed almost unnecessary to enlarge here; for it has been recognized and enforced by teachers and moralists in all ages; and with the utterance of one of the latest and most eminent of these this article may fitly conclude:—"Habit is our primal fundamental law; Habit and Imitation, there is nothing more perennial in us than these two. They are the source of all Working and all Apprenticeship, of all Practice and all Learning in this World" (Carlyle, "Past and Present").

HABIT AND REPUTE. In Scotch law this phrase signifies a condition of things in which the public belief is so strong as to be taken as a legal proof of the matter. Its most important application is in regard to marriage, which may be established where the parties live together and pass among their neighbours as man and wife, by the mere fact of their doing so. In such a case the law presumes that there has been a mutual consent to a marriage contract, but the cohabitation must have been regular and consistent, and for a reasonable period, and the repute must have been general, uniform, and undivided. If the cohabitation began in avowed concubinage, a clear and unequivocal change of purpose must be shown in order to establish a marriage by habit and repute. When the cohabitation began in adultery the matrimonial consent was in one case presumed to have been given as soon as the parties became free to marry.

The phrase is also used in connection with the criminal law, and where a man has for a period of not less than one year been a thief by habit and repute, *i.e.* an "old offender," he becomes on conviction liable to a sentence of extra severity. A similar practice prevails in the criminal law of England, but the phrase is not used as a legal term.

HABITUAL CRIMINALS ACT. This was the title of an Act of Parliament passed in 1869 (the 32 & 33 Vict. c. 99). It introduced the novel feature into English criminal law of depriving criminals of the presumption of evidence, and placing upon them the onus of proving they were living honestly. The Act was repealed, but its principle extended, by the Prevention of Crimes Act of 1871 (34 & 35 Vict. c. 112), under which any person holding a ticket-of-leave license must report himself to the police monthly, and also report any change of residence, on pain of forfeiting the license and being imprisoned for a year. Registers of criminals have to be kept, and all prisoners must be photographed. Where a person is convicted after a former conviction the court may direct that he be subject to police supervision for seven years or less, and every person subject to such supervision has to report himself to the police in the same manner as a convict having a license. When a woman has been twice convicted, any of her children under fourteen, being under her care and having no visible means of subsistence, may be ordered by the court to be sent to an industrial school. The Act also contains very stringent provisions against persons who harbour thieves and receivers of stolen goods.

HACK'BERRY. See NETTLE-TREE.

HACKNEY COACH or **CARRIAGE.** The derivation of the word hackney, as applied to a class of public conveyances, is uncertain. (Probably it comes from the old Dutch *hakken*, to chop, perhaps to jog or jolt, and *negge*, a nag.) It was applied to horses let for hire, and then, by a very natural transition, extended to coaches employed in a similar way.

Hackney-coaches appear to have originated in London. It was in 1625 that they began to ply in London streets, or rather at the inns, to be called for as they were wanted, and they were at this time only twenty in number. In 1652 the number of hackney-coaches daily plying in the streets was limited by the government to 200; and an increase was at different times allowed till 1771, when the number of coaches was further increased to 1000. They were long assailed as public nuisances.

The first hackney-coach *stand* was established in 1634, by one Captain Baily, near the Maypole in the Strand. The monopoly long enjoyed by the London hackney-coachmen produced great indifference to the wants of the community. While this was the state of things in London a lighter kind of vehicle, called *cabriolets de place*, had been brought into extensive use in Paris. In 1823 licenses were obtained for eight cabriolets (or as more commonly called for brevity, cabs) to be started in London at fares one-third lower than those of hackney-coaches. With the rapid extension of this lighter class of vehicles, numerous varieties of construction have been introduced, in which comfortable and safe accommodation, with complete shelter from the weather and separation from the driver, is provided for two, three, or four persons. The name *cab* is still commonly applied to all hackney-carriages drawn by one horse, whether on two or four wheels. During the first few years of the employment of such carriages their number was restricted to sixty-five, but in 1832 all such restrictions were removed.

Within the last few years the cabs of London have greatly increased in number, and have decidedly improved in quality, as well as in the general character and conduct of their drivers; but they still furnish subjects for complaint to those who love to exercise the privilege of grumbling, and occasionally even to those who do not grumble without a cause.

Prior to 1869 the control of hackney-carriages was vested in the board of inland revenue, but in that year it was transferred to the commissioners of police, and at the same time the taxation of the proprietors was greatly lightened. The number of cabs has since nearly doubled.

The secretary of state for the home department has power to make such regulations with regard to cabs as he may consider most conducive to the public convenience; and the chief commissioner of police is required by Act of Parliament to see that cabs are maintained in a state "fit and proper" for the public service. He discharges the duty thus imposed upon him by means of an annual inspection of every cab, and by a police supervision of cabs in general.

In a few cases the cabman is the owner of the vehicle he drives, but generally speaking a proprietor lets out his cabs by the day to licensed drivers, who undertake to pay him a sum agreed upon between them. This sum, for a well-appointed "hansom," with a good horse, and in a busy time, may be as much as a guinea a day, and is commonly 18*s.*, while for an inferior "clarence," and in a slack time, it may be as little as 6*s.*

HAD'DINGTONSHIRE is one of the three counties of Scotland included under the general name of the Lothians, and is very commonly called *East Lothian.* It is bounded S.W. by Edinburghshire, S.E. by the Lammermuir Hills, and N. and E. by the Frith of Forth and the German Ocean. It is comprised between 55° 46′ and 56° 5′ N. lat., and 2° 20′ and 3° 2′ W. lon. Its length from E. to W. is about 27 miles, and width from N. to S. less than 16 miles. The area is 173,637 acres, or 280 square miles. The population in 1881 was 38,472. The county returns one member to Parliament.

Soil and Surface.—The surface of the county is extremely diversified, though not mountainous. The principal hills are those of the Lammermuir. The general inclination is from the foot of the Lammermuir range towards the north-east, but the descent is far from uniform. From the shore of the Frith of Forth the county consists of a series of parallel ridges running from west to east, and successively increasing in altitude until they reach the Lammermuir Hills. The soil is very varied in quality in different parts; about four-fifths are under tillage, and the remainder consists of woods, plantations, pastures, and wastes. The climate varies extremely for so small a county, and the period of harvest is a month later in some spots than in others.

The geology of the county presents many points of considerable interest. The tract of country lying between Traprane Law and North Berwick on one side, and Gullane Point and Whitberry Point on the other, is composed chiefly of porphyries and trap. The Lammermuir Hills, on the south-east of the county, consists for the most part of the Silurian rocks of the south of Scotland. Near Dunbar, and stretching to the south-west in the direction of the low slopes of the Lammermuir range, the old red sandstone formation is well developed. The rest of the county consists of rocks belonging to the coal measures, in which coal, ironstone, freestone, and limestone occur. Patches of stratified rocks crop out on the coast in the neighbourhood of North Berwick. These have generally been set down as the old red sandstone. But this can hardly be the case, since some slight indications of carboniferous plants have been found in them.

The source of the Tyne is in Mid Lothian, a few miles west of Haddingtonshire; and its mouth is about 3 miles westward of Dunbar. The river abounds with large trout, eels, and small salmon. The other rivers, or waters, as they are provincially termed, are—the Coalstone, Biel, Whitewater, and Fastna, to the south of the Tyne, and the Peffer to the north, by means of which and their tributaries nearly the whole county is well watered.

Agriculture.—The farms are generally large, and the farmers men of capital, skill, and intelligence. In fact, it is from Haddingtonshire that the improved system of agriculture has been diffused over Scotland, and this county continues to hold a high rank in respect of agriculture and produce. Great attention is paid to the drainage of the soil, and the best agricultural implements are used. The first steam-plough used in Scotland was introduced in this county. The turnip crops are very large. Since the increase of pasture-land the breeding of sheep and cattle has been extended, but breeding in the lowland and midland districts is carried on upon a very limited scale, the more usual practice being to purchase, chiefly from the Highlands, and fatten for the Edinburgh market. In 1884 there were 117,000 acres under cultivation, 45,000 acres being devoted to corn, chiefly barley and oats; 25,000 acres to green crops, and 47,000 to clover and other grasses and permanent pasture. The number of cattle in the county at the same time was 46,000, and of sheep 120,000.

Coal is worked in the west, and limestone abounds everywhere. Near Dunbar are some extensive fisheries, and that town has a large trade in both salt and cured herrings. Salt is also manufactured there. There are several extensive distilleries in the county, and also some pottery works.

Antiquities.—Circular mounds or encampments are occasionally met with in conspicuous situations. Some years since the proprietor of Seacliff, near North Berwick, discovered on a low skerry, west of Seacliff House, urns of the Roman and Celtic periods, a bone comb, a bone needle, a flint implement; and many bones of oxen, sheep, goats, dogs, foxes, birds, fishes, &c. With these one or two fragments of human bones occurred. Some of the bones of the oxen were evidently those of the marsh cow (*Bos longifrons*). There are numerous old castles, some in a tolerable state of preservation. Of these it will be sufficient to mention Dunbar and Hailes, Tantallon, once the residence of the Douglases, which stands close to the sea, Dirleton, and Luffness.

HADDINGTON, the capital of the above county and a very ancient royal burgh, is situated on the Tyne, which is here crossed by four bridges, 18 miles from Edinburgh, and 391 from London by the Great Northern and North British Railways. The parish comprises 12,113 acres, which are in the highest state of cultivation. The town has parish and collegiate churches, a town-house, county buildings, corn exchange, an agricultural and a horticultural society, several public libraries, and in 1880 a handsome town cross was presented to it. The Knox Memorial Institute, which now contains the celebrated grammar school, must also be mentioned as an important building. It was finished in 1880. The industrial activity of the town is now small, but there are still some wool-mills, breweries, and agricultural implement factories, and it is perhaps the largest market in Scotland for corn and other agricultural produce. Haddington is a very ancient royal burgh, and holds its last charter, dated 1624. It is governed by a provost, three bailies, a dean of guild, a treasurer, and twelve councillors. Its most important historical event was the long siege it sustained when garrisoned by an English force after the battle of Pinkie, and at one time a curious custom prevailed for the crier to go round the town on winter evenings and warn the inhabitants in rude verse to see to their fires and lights. It was called the "Coal an' Can'le," and originated from the town having suffered in 1598 from a fire, which arose from the carelessness of a servant. Haddington disputes with Gifford the honour of being the birthplace of the celebrated reformer, John Knox. The old abbey, a fine Gothic structure in partial ruin, is a very interesting object. The suburb of Nungate, or Abbey, joined by a bridge of four arches, was named from a nunnery established here in 1178, where was convened (1548) the Parliament which sanctioned the marriage of Mary with the Dauphin of France. Haddington, with Dunbar, Jedburgh, Lauder, and North Berwick, formerly returned one member

to Parliament. There are many fine seats in the neighbourhood. The population of Haddington is 4003.

HAD'DOCK (*Gadus æglefinus*) is a fish belonging the family GADIDÆ, and to the same genus as the common COD. The haddock is brown above and silvery below; the lateral line is black. Above the pectorals are blackish spots, the marks, according to the popular legend, of St. Peter's finger and thumb when he took the tribute-money from this fish's mouth. A fatal objection to this story is that the haddock does not exist even on the coasts of Palestine, much less in the inland Sea of Galilee. This fish is plentiful in the North Atlantic, both on American and British coasts, and in the German Ocean. It does not enter the Mediterranean. Haddocks usually weigh from 2 to 4 lbs., but a weight of 25 lbs. is recorded on the Irish coast. Rarely a length of 3 feet is attained. Haddocks swim in vast shoals.

The haddock is finer on the Scottish coasts than in the southern parts of England, and is consumed in large quantities in Edinburgh, Glasgow, and other important towns. Dried in a peculiar way at Findhorn, it becomes the "Finnan haddie," which is a northern delicacy and is exported to London, but deteriorates greatly if kept beyond a very few days. Dried more perfectly, so as to keep longer, it is called "speldron," a much inferior article to the other. The Finnan, Buckie, and Bervie smoked haddocks are the most prized.

HA'DES (Gr., the grave), in ancient theology and classical mythology, the nether world or place of departed spirits. In the old or Authorized Version of the New Testament it is incorrectly translated *hell*, and Jews, Mussulmans, and Christians have all depicted the horrors and punishment of hell as their several fancies have conceived, and according to various images derived from bodily tortures and pangs; whereas Hades comprised the Elysian fields as well as the place of punishment. The term, in all probability, was derived by the Greeks from the ancient Egyptians, who considered Hades as a place of separate abode for the soul preparatory to judgment. Hades (Aïdes) is the more correct name of the ruler of the underworld, or PLUTO.

HADJ, HAJJ, or **HAJI,** the sacred pilgrimage of the Mohammedans. The practice of undertaking long journeys for the sake of visiting a sacred place, or the performance of special religious ceremonies, is one which has always prevailed to a great extent among Orientals. Such journeys were common among the Jews, and are frequently referred to in both the Old and New Testaments; while among the Arabs we find that pilgrimages to Mecca, in honour of certain idols, were made long before the time of Mohammed. The prophet confirmed the practice, but destroyed the idols, and substituted observances more in accordance with the new faith; and it is a fixed opinion among his followers that every true believer must at least once in his life, if his means and health permit, make the journey to the Caaba at Mecca. This pilgrimage entitles the person performing it to the title of "Hadji;" the pilgrimage is called the "Hadj," and the place of pilgrimage is the "Hedjaz." The Mohammedans regulate their time by lunar months, and their ceremonies vary in date every year; but the month Dsul Hadjeh, the twelfth month of their year, is the time appointed for the celebration of the solemnities, and the pilgrims have to set out one month or two months earlier, according to the distance they have to traverse. Every year agents are sent out to every Mohammedan country to raise contributions for the support of the Caaba, and to draw up lists of those who intend making the journey. Men of all ranks, and from all parts of the Mohammedan world, perform this pilgrimage, and in the crowd of from 50,000 to 80,000 people which the Hadj brings together, men from Morocco, Turkey, and Egypt meet others from Afghanistan, India, and China. The pilgrimage receives the support both of the sultan and the khedive, and these annual gatherings exercise very great influence over Mohammedan thought and feeling. The pilgrims from India land at Jeddah, and go first to Mecca; those coming by sea from Suez land at Zambu and pass to Medina; those who go by land from Egypt cross the Sinaitic peninsula to the head of the Gulf of Akabah, the Syrian or Damascus caravan going southward by the great Hadj road.

As soon as the pilgrims arrive at a certain distance from Mecca they enter what they believe to be holy ground, and they then assume the special pilgrim habit. This consists of two pieces of white cloth, one of which is wrapped round the middle and the other around the shoulders; the head must remain bare, and the sandals or slippers worn must not cover either the heel or the instep. The pieces of cloth are treasured afterwards very carefully to be used as winding sheets for burial. Arrived at Mecca various rites are performed, the most important of which consist in walking seven times round the Caaba, touching and kissing the sacred stone; in running seven times between the two mounts Safá and Merva; the spending of a night in prayer at a place called Mogdalifa, throwing seven or seventy stones at a cairn supposed to be the abode of the devil; the offering of a sacrifice, and drinking and washing in the water of the well Zem-Zem. The pilgrims are also accustomed to shave their heads and cut their nails while on the holy ground, and they usually carry away some of the dust, the water of the well, &c., as sacred souvenirs of their visit. The return of the pilgrims is celebrated in Mohammedan countries with great rejoicings, and every man who has made the journey is distinguished for the remainder of his days. Since the introduction of steamboats and railways many of the pilgrims make use of them to perform as much of the journey as possible. A good trade is done in the conveyance of pilgrims between India and Arabia, and though the dangers and difficulties of the journey are thus sensibly diminished the merit acquired is believed to be the same. Mohammedans unable to make the journey through age or bodily infirmity may obtain the merit by sending a substitute, but a pilgrim who goes as a substitute for another is excluded from personal share in the honour of the undertaking.

HADLEY, JOHN, the reputed inventor of the sextant which bears his name, became a fellow of the Royal Society in 1717, and died 15th February, 1744. He was author of several useful papers, which appear in the *Transactions* of the society, from vol. xxxii. to xxxix. He was also upon intimate terms with Sir Isaac Newton, from whom it is supposed he borrowed, without acknowledgment, the idea of the sextant. It is now generally believed that Newton and Godfrey were the original and independent inventors of that instrument. Hadley gave an account of the instrument the *Philosophical Transactions* for 1731; but Newton, previous to his death in 1727, had given a description of the instrument to Dr. Halley, by whom it was, for some unknown reason, suppressed, though it was communicated to the Royal Society in the year 1742, after Halley's death by his executor, Mr. Jones.

HA'DRIAN, the great Roman emperor (Publius Ælius Hadrianus), son of Ælius Hadrianus Afer (a cousin of Trajan, and a native of Hatria Picena, but of Spanish descent) and of Domitia Paulina of Cadiz, was born at Rome, in January, A.D. 76. He was left an orphan at ten years of age, under the guardianship of Trajan, afterwards emperor. He made great progress in literature, especially in the study of Greek. Trajan gave him his grandniece Sabina in marriage, and he accompanied the emperor in his Dacian and Eastern campaigns. When Trajan died at Selinus in Cilicia, in August, 117, Hadrian, whom he had left in charge of the army in Syria, was proclaimed emperor by the soldiers at Antioch, and after making peace with

the Parthians and the Armenians set off for Rome. He refused to appropriate to himself the triumph which had been destined for Trajan, and he caused the image of the deceased emperor to be carried in the triumph. He burnt in the Forum of Trajan the schedules of all debts due to the treasury, which are said to have amounted to several millions sterling. Medals were struck on this occasion with the figure of Hadrian holding a torch and setting fire to the heap. In 119 he repaired to Mœsia, and drove back across the Danube the Sarmatians and Roxolani, who had invaded the Roman territory. The year after Hadrian began his travels through all the various parts of the empire, which occupied, with few interruptions, the remainder of his reign. He was the only emperor who really visited the whole empire. We have memorials of his travels in numerous medals, struck in the various provinces on the occasion of his visit. He affected no pomp or state in his travels, but lived like a soldier among the soldiers.

In the course of these journeys, in 119, he crossed over to Britain, where he reformed many abuses. While in Britain he constructed a rampart of earth, extending from the Solway Frith to the German Ocean near the mouth of the Tyne, a little to the south of the more substantial wall afterwards raised by Septimius Severus. In fact he had a passion for architecture as a public work, and his army was always accompanied by a staff of architects and builders under the military organization of a legion.

He returned to Rome in 126, having visited all the Roman provinces in Europe, and in 129 he set off for Africa, where he distinguished himself, as he had done on his previous travels, by his munificence and care for his subjects' welfare. Plautina, Trajan's widow, having died meantime, Hadrian returned to Rome, and celebrated her funeral with great ceremony. In the following year (130) he raised a magnificent double temple in honour of Venus and Roma, some remains of which are still seen near the arch of Titus. In that year Hadrian set off again for the East. He visited Cappadocia, Syria, Palestine, and Egypt, in which last country he remained two years. There is a letter of Hadrian, written from Alexandria, to Servianus, his brother-in-law, in which he describes the state of the population of Egypt and speaks of the various sects, Jews, Christians, and Samaritans, who were numerous in that country. He says that they all adored but one god, their own interest. He restored the palace and museum of Alexandria. About this time his favourite Antinous died, and Hadrian lowered himself by the apotheosis and other absurd honours which he paid to his memory. In 133 Hadrian repaired to Syria, from whence he set off for Thrace and Macedonia, and lastly stopped at Athens. He had raised a new city on the ruins of Jerusalem, which he called Ælia Capitolina, and peopled it with a Roman colony. Jews and Christians were forbidden to enter the new city. Circumcision was also forbidden. As a result the Jews had revolted under Barcochebas, and in 132 had taken Jerusalem. So fiercely did they fight in what they held a most sacred cause that Hadrian saw it was necessary to put forth the whole strength of the empire. Julius Severus was recalled from Britain and the revolt was got under by A.D. 135. It is said 580,000 Jews perished. Hadrian meantime made another long residence at Athens, and he greatly embellished that city, a district of which was called by the name of Hadrianopolis. He also completed the temple of Jupiter Olympius. He returned to Rome again in 135. Soon after, falling ill, he thought of choosing a successor, and he fixed his choice upon Ceionius Commodus Verus, whom he adopted and appointed Cæsar by the name of Ælius Verus. In the following year Hadrian retired to the neighbourhood of Tibur, where he built a magnificent villa, many remains of which still exist. The grounds were 8 miles in circuit, and were filled with representations, on a small scale, of famous buildings and landscapes. The emperor suffered greatly during the latter years of his life, and was, indeed, only withheld from suicide by the good Antoninus. The same noble influence often restrained him when the irritability of the sick-bed overcame his kindly nature; but enough severities were experienced at Hadrian's hands to make the senate pause before decreeing the usual divine honours to him. Ælius Verus having died in the second year after his appointment as Cæsar, Hadrian fixed his choice upon Titus Aurelius Antoninus, on condition that he should adopt Lucius Verus, son of Ælius Verus. Antoninus (afterwards called Antoninus Pius, because of his respect to Hadrian's memory and the devoted way in which he beset the senate till his "father" received divine honours) accepted the proposal, and the double adoption was solemnized in February, 137. Hadrian still finding his illness increasing, at last removed to Baiæ. He

Coin of Hadrian in the British Museum--actual size (copper).

died in July, 138, in his sixty-third year and the twenty-first of his reign. His magnificent mausoleum, now turned into the fortress of St. Angelo, is even in its mutilated state one of the glories of Rome. Hadrian was a man of great abilities and large acquirements, an encourager of architecture, a great lover of painting and sculpture, a good administrator, and very attentive to business. But he was not free from vices, if we may trust the evidence of the historians. It is said that he was the first emperor who allowed his beard to grow, in order to conceal some blemish on his face. Under Hadrian the distinguished jurist Salvius Julianus compiled the "Edictum Perpetuum," or fixed code of laws. It is always held that under Hadrian, and greatly owing to his watchful care over every region of the vast realm he governed, the empire was at its happiest and most flourishing point.

The busts, statues, and medals of Hadrian are very numerous.

HADRIAN (Popes). See ADRIAN.

HÆM'ATIN or **HÆMAT'OSIN**, the red colouring matter of the blood. It can be obtained from the clot of blood in small dark crystals, of a reddish-brown colour. It is insoluble in water, alcohol, and ether. It is soluble in alcohol when acidulated, and is precipitated from the solution by the addition of water. It contains iron, and is difficult to obtain in perfect purity. The formula is $C_{34}H_{34}FeN_4O_5$.

HÆMATOX'YLIN or **HEM'ATIN**, the red colouring matter of the common logwood (*Hæmatoxylon campechianum*, natural order Leguminosæ). It is usually obtained in yellow crystals, containing either one or three equivalents of water. When quite pure it is colourless. It is best extracted by ether, in which it is very soluble. It is likewise soluble in alcohol, and slightly so in water. It is more soluble in solution of borax, from which it is precipitated by the addition of an acid. The taste is very sweet. The solution is not altered by exposure to air,

but the presence of ammonia at once turns it red. The colour is due to the formation of hæmatente of ammonia. The formula is $C_{16}H_{14}O_6$. It forms a number of coloured salts with mordants, and hence is much used in dyeing; the compound with tin is rose-coloured, with lead blue, and with iron violet or nearly black.

HÆMODORA'CEÆ, an order of plants nearly allied to the Iris and the Amaryllis families, and belonging to the same series, Epigynæ, of the Monocotyledons. [See BOTANY.] They differ from Amaryllids in their usually woolly perianth, the ovary sometimes superior, and root never bulbous; and their anthers, splitting towards the centre, separate them from the Irids.

Lachnanthes tinctoria, a native of North America, affords a red colouring matter, used occasionally for dyeing. Other plants of this order also yield a red colour. The roots of species of Anigozanthos and Hæmodorum are roasted and eaten by the natives in Australia. An infusion of *Aletris farinosa* yields an intensely bitter and astringent principle, which is used in small doses as a tonic and stomachic. The flowers of many genera are small; others again are showy and conspicuous; for instance, those of Anigozanthos and Wachendorfia. Barbacenia and Vellozia, which used to be included in this order, are now removed to Amaryllideæ. There are 120 species distributed among twenty-six genera, natives chiefly of South-west Australia, South Africa, America, Mid and East Asia.

HÆM'ORRHAGE (Gr. *haima*, blood, and *regnumi*, to break). The most common cause of hæmorrhage is external violence, by which the vessels of a part are divided, and the blood escapes from their cavities. When an artery is wounded a bright scarlet stream of blood is emitted in a current, continuous, but increased in force at intervals corresponding with the pulsations of the heart. If a vein of some size be divided a stream of dark crimson blood is projected in a perfectly continuous and equable current. In wounds in which no vessel of more than a line in diameter has been divided, the blood flows in a constant more or less rapid oozing.

When a large artery, as one of the main trunks of the limbs or head, is divided, the blood rushes forth with such impetuosity that life is often destroyed almost instantaneously. When an arterial branch of the second magnitude, as one of the primary divisions of the main trunks in the leg or forearm, is wounded, the flow of blood is at first profuse, and a large quantity is soon lost; but after a time the patient faints from extreme exhaustion, and then the heart, ceasing to act, the blood no longer flows, but begins to coagulate both within and around the vessel, whose extremities contract, and further loss may thus be prevented. From arteries of smaller size, as those about the fingers, &c., the blood flows at first in a rapid little stream; but after a few minutes, if they are exposed to the cold air, they retract, their orifices contract and close, and the bleeding altogether ceases, without much danger of returning.

Hæmorrhage from wounded veins is of less importance. It is much more slow, for the blood is prevented by the valves from flowing from that part of the vein which is between the heart and the orifice, and in the part which is beyond the orifice it has only the force of that in the smaller arteries. Hence it is seldom immediately fatal; and when the patient becomes faint the edges of the vessel fall together, instead of remaining open, as those of arteries. Thus a coagulum forms within and round them, and, except from the largest trunks, prevents any further flow.

Of the means of arresting Hæmorrhage.—The simplest of these is pressure, and if the finger be placed with moderate firmness over the mouth of a small bleeding vessel for a few minutes, on removing it the orifice will be found closed and no more blood will flow. Where the vessel divided is too large for this, it will be necessary to observe whether it is an artery or a vein that is divided, and in the former case to apply pressure between the wound and the heart, and in the latter below the wound on the side furthest from the heart. A good temporary tourniquet may be made by binding a strip of bandage or even a handkerchief round the limb, and tightening it by means of a stick passed through the knot. A wine cork placed under the bandage in the situation of the vessel forms a valuable addition to the bandage, as it exercises a more efficient pressure. After the flow of blood has been arrested, the patient should lie down with the head low and remain as quiet as possible. Where bleeding has been at all severe surgical assistance should be obtained as soon as possible, for though the flow may be checked by the means indicated, more important measures may be required if life is to be preserved. Where the important operation of tying the artery is required, it will be necessary, if it be completely divided, for ligatures to be placed upon both extremities; and, if only partially cut, then on both sides of the opening, for from the numerous communications of the arteries, when the main current is checked another in a retrograde direction is always established into the part beyond the ligature. Sometimes astringent applications, as alum or sulphate of copper, will arrest slight bleeding. Spongy substances, as lint, agaric, &c., act mechanically in arresting hæmorrhage.

Such are the principal modes of treatment applicable in cases of external or surgical hæmorrhage, in which vessels are divided by external injury, and are within the reach of the eye or fingers. In internal hæmorrhages, however, it is obvious that mechanical means can rarely be employed. From the varied nature of the causes from which they arise, it is evident that different means will be required, according to the several conditions of the system. If astringent remedies be deemed advisable, and in many cases they are highly useful, the acetate of lead will generally be preferable, and next to it the different vegetable compounds of gallic acid.

HÆM'ORRHOIDS or **PILES.** The terminal portion of the bowel, the rectum, is a part of the body that is subject to many serious derangements, and one of the most common is that which is caused by the veins becoming dilated and varicose, and thus forming hæmorrhoids or piles. When these are situated inside the anus they are termed *internal*, and when they occur outside the opening they are termed *external* piles. Sometimes the internal piles grow so large as to protrude through the anus when any pressure from above is applied, as at stool, and occasionally they come down even when the patient is standing or walking about. External piles commonly give rise to a feeling of heat and tingling, and when the bowels are costive the excrescence becomes swollen and tender, and causes considerable discomfort. Internal piles give rise to similar symptoms, with the frequent addition of itching and irritation, a feeling of weight and fulness at the part affected, while considerable pain attends the motions. Another common symptom is the passing of blood, which is sometimes lost in considerable quantities.

Hæmorrhoids occur in both sexes, and are usually not met with until after puberty, but they are exceedingly common among those who have reached middle life or the period beyond it. They arise from a variety of causes, the principal of which are sedentary habits, rich living, insufficient exercise, habitual constipation, the frequent use of irritating aperient medicines, and a prolonged residence in hot climates. They are frequently present during pregnancy, and sometimes remain during the whole period in spite of treatment, though after it they will often get well of themselves.

The treatment of hæmorrhoids must of necessity be varied, according to the nature of the complaint; but so many useful remedies are known to medical science that

in the majority of cases they may either be considerably relieved or wholly cured. It must be remembered that they are chiefly a symptom, and when the cause is removed the effect will disappear. Hence attention must be paid to the general health, the state of the liver and bowels, and the diet must be carefully regulated. Sometimes hæmorrhoids are only troublesome when the system has been unduly excited, and in such cases alcoholic stimulants should be avoided, and also all highly seasoned and stimulating foods. Laxative medicines are often of great service, but violent or continued purging is harmful and often increases the mischief. Local treatment consists in the use of lotions, ointments, the use of injections, hot fomentations, hip baths, and poultices. Where there is a discharge of blood, one of the best remedies known is found in the tincture of *Hamamelis virginica*. This is administered internally by mixing a teaspoonful of the tincture with eight ounces of water, and giving a dose of three teaspoonfuls every three hours. An external application should be used at the same time, a lotion being made by adding two teaspoonfuls of the tincture to half a pint of water. If the hæmorrhoids are external the lotion may be applied by means of a fold or two of linen covered with oiled silk, and if internal by means of an injection. The injection of half a pint of cold water every morning before the usual motion is often of great service. Where the hæmorrhoids are of large size and cause much irritation, or where they cause a serious loss of blood, their removal by a surgical operation may become necessary.

HÆ'MULON is a genus of fishes of the perch family (Percidæ), of the order ACANTHOPTERYGII. The generic characters are—a single dorsal fin, with twelve or thirteen spines; seven branchiostegal rays; the vertical fins partially covered with scales; cleft of the mouth horizontal, generally wide, with the jaws equal in length anteriorly; a central pit below the chin; the jaws armed with fine conical teeth; the palate toothless. These fishes generally approach to an elongate oval form; the body is moderately compressed and covered with ctenoid scales; the tail is forked; the dorsal fin, which occupies the greater portion of the distance between the back of the head and the tail, although continuous, has a considerable indentation at that part where the spinous rays join the flexible. The portion of the under jaw which is covered by the upper when the mouth is closed is invariably of a bright red colour. The species of Hæmulon chiefly inhabit the Caribbean Sea, and are eaten by the inhabitants of the West Indian Islands. They are of moderate size, varying from 6 inches to 1 foot in length, and generally adorned with longitudinal or oblique dark markings on a pale ground colour.

HA'FIZ, MOHAMMED SHAMS-AD-DIN, the greatest lyrical poet of Persia, was born at Shiraz in the beginning of the fourteenth century of the Christian era. At an early period of his life he devoted himself to the study of theology, philosophy, and poetry, his principal teacher being the chief of an order of dervishes named Mahmud Attar. To this order Hafiz attached himself while a young man, and he remained a member to the end of his life. He was patronized by two of the ruling princes of the house of Muzaffar, one of whom founded a college in order to appoint him professor. It is probably from this circumstance that the poet derived his name Hafiz, which literally means "one who remembers," and was applied to all those who learned the Koran by heart. His fame as a poet caused him to receive pressing invitations from several important Mohammedan monarchs; but he refused to leave his native place, and died at Shiraz at a ripe old age, in the year 791 of the Hegira, or 1388.

Although a dervish and a professor of Koranic exegesis, he seems to have disregarded the rules of asceticism and to have been given to wine and the pursuit of pleasure. His mode of life drew upon him the severe censure of the more rigid members of his order, whose hostility he repaid with merciless satire and ridicule. He was further accused of heresy, and after his death the usual prayers over the dead body were refused, and his right to burial in consecrated ground was denied. The controversy, however, was decided by an appeal to the works of the poet, which had already begun to be employed for divination, and which gave a verdict in his favour, and he was buried at Shiraz, and a beautiful tomb erected over his remains. This was visited and described by numerous European travellers, but it was thrown down by the earthquake of 1853.

The poems of Hafiz consist of a series of short odes or sonnets celebrating chiefly the pleasures of love and wine. They have always been greatly admired in Persia and widely read throughout the East, where they have found numerous editors and commentators. By many Mohammedans they have been condemned as having an irreligious and licentious tendency, which certainly must be admitted if they are interpreted in a literal sense. The admirers of Hafiz, however, maintain that his poems are not to be understood literally, and that they express in emblematical language spiritual truths of the highest importance. The system of Sufism developed among the Persian shiahs, to which Hafiz belonged, has always possessed a series of esoteric doctrines, which have found expression chiefly in symbolical language, and they possess many poems which are undoubtedly of this description. Such a method of teaching has always found favour in the East, and most Christian commentators regard the Song of Solomon in the Old Testament as a poem of this character.

The poems of Hafiz were arranged after his death by Said Kásem Anvári, in a collection called the "Díván." This contains, according to the best MSS., 571 odes or ghazels, but there are about eighty more poems in existence which are attributed to Hafiz. The "Díván" was published in the original Persian at Calcutta (one vol. folio, 1791); this edition contains only 557 ghazels and seven cassidehs or elegies. The whole "Díván" was translated into German by Von Hammer (Tübingen, 1812); and several of the odes have been translated into English by Richardson: "Specimen of Persian Poetry, or the Odes of Hafiz, with an English translation and paraphrase, chiefly from the Specimen Poeseos Asiaticæ of Baron Rewnski" (London, 1774); Nott, "Select Odes of Hafiz, translated into English verse" (4to, London, 1787); Hindley, "Persian Lyrics, or scattered poems from the Diwah-i-Hafiz" (4to, London, 1800).

HAG (Myxine) is a genus of fishes forming with the lampreys the order MONORHINA. This order contains fishes of a very low organization. By many recent authorities it is separated altogether from the class Fishes (Pisces) and ranks as a distinct class of Vertebrata. The Glutinous Hag or Borer (*Myxine glutinosa*) is an inhabitant of the northern seas of both hemispheres. It is a true parasite, making its way into the bodies of fishes, especially the cod and haddock. As many as twenty of these parasites have been found in a haddock which had died when suspended to a hook. They had consumed all the flesh to within 2 or 3 inches of the gills. When from any cause a series of hooks have not been visited for a week or so, the fishermen on taking them up often find merely skeletons of fish hanging to them, the borer having picked the bones clean. The hag secretes a thick glutinous slime in enormous quantities. It lives in deep water, preferring a clayey or muddy bottom. It is sluggish in its habits, but swims like an eel, which fish it resembles in form. There are no limbs, and the mouth has no lips. The nasal aperture is single. Two other species are known. There is also a closely allied genus, Bdellostoma, of which two species are known from the South Pacific.

HAG'GADA (Heb., from *nagad*, *hagged*, to say), an element in the Jewish Talmud distinguished from the authoritative Halacah as being made up of free interpreta-

tions of Scripture, and including a vast series of legends, allegories, parables, stories, which, though valued for their moral and instructive character, are not to be received as inspired or infallible. A compilation of these materials, which had been accumulating from the time of the Babylonian captivity, was commenced about 700 A.D., and was concluded about two centuries later, being called the "Midrash Rabboth," and this formed the basis for the compilations of later rabbis. The objects of the Haggada were to explain the literal meanings of the sacred text, to fill up those portions of history, &c., that are omitted there; to show, by methods of interpretation peculiar to itself, the manifold mysteries which it was supposed the Scriptures concealed; and to draw practical applications from its precepts. It has always enjoyed considerable popularity among the Jews, and the influence of its teachings can be traced in the religious systems of both the Eastern and Western worlds. See MIDRASH and TALMUD, and also the observations of Emmanuel Deutsch in his "Literary Remains" (London, 1874).

HAG'GAI, the tenth in order of the minor prophets, and the first of those who prophesied after the return from Babylon. The Bible is silent as to his tribe, parentage, and personal history, but according to one tradition he was born at Babylon of a priestly family, and was one of the exiles who returned with Zerubbabel and Joshua; while another theory, partly suggested by the prophet's own words (chap. ii. 3), regards him as being one of the few who remembered the first temple, and regards his prophecy as being delivered in extreme old age.

The book contains four short prophecies delivered between the first day of the sixth month and twenty-fourth day of the seventh month (between September and December) of the second year of Darius the king, who must be Darius Hystaspis. The return to Palestine had been attended with much trouble, and many difficulties and disappointments had beset the few returned exiles, who, in their struggles against poverty and the hostility of their neighbours, had neglected to rebuild the temple. In his first message the prophet ascribes the then existing famine to this neglect, and urges the people to the work; he then exhorts them not to be disheartened at the inferiority of the second temple to its predecessor, promises a removal of the famine and a time of plenty, and finally pronounces a blessing upon Zerubbabel, the governor.

The style of the book is very tame and prosaic, and it is marked by such poverty of expression and frequent repetition of terms, that some critics have suggested the idea that the book as we have it is but an abridgment or outline of the original discourses of the prophet.

HAGUE, THE (in Dutch, *'s Gravenhage;* in French, *La Haye*), a large and beautiful city, the capital of the Dutch province of South Holland, stands at a distance of 2 miles from the North Sea, 37 S.W. from Amsterdam, and 13 N.W. from Rotterdam by the railway which connects those cities. It is not fortified, but is surrounded with a moat crossed by drawbridges. It is ranked as one of the finest cities in Europe on account of its handsome buildings, its broad and regular streets traversed by canals, and its pleasant, dry, and healthy situation. Many of the streets are planted with rows of trees and paved with coloured bricks. The finest parts of the town are the Voorhout, which is lined with trees and contains several large hotels, and the Vyverberg, a sort of square with a fine avenue of trees on one side, and on the other a spacious basin of water, backed by fine buildings. Among the public buildings are—the royal palace, a building of little pretension; the former residence of the stadtholder, in which the States-general now hold their sittings; the palace of the Prince of Orange; the Buitenhof, which contains a gallery of pictures; the town-hall, the brass-cannon foundry, the theatres, and the state-prison. The Binnenhof, on one side of the Vyverberg, contains a fine Gothic hall, the only remaining portion of the original residence of the counts of Holland. The Mauritzhuis contains the finest collection of paintings by Dutch masters in the world. a vast collection of Chinese and Japanese products and curiosities, besides numerous historical relics. The Royal Library in the Voorhout contains 100,000 volumes and a collection of 34,000 medals. De Witt's house in the Kneuterdyk, and the Gevangepoort (prison-gate), from which Cornelius and John de Witt were dragged by the populace and torn to pieces in 1752, are historically interesting. There are numerous churches—the most notable being that of St. James, with its lofty hexagonal tower and peal of thirty-eight bells—several Jews' synagogues and Protestant chapels, numerous charitable and scientific institutions, and fine private collections of pictures. There are a royal country seat and numerous elegant villas in the environs.

The Hague owes its origin to a hunting-seat built by the counts of Holland in 1250, and the Dutch name, 's Gravenhage (counts' hedge), is said to be taken from the circumstance that houses came to be erected along the inclosure surrounding the counts' park. In the sixteenth century the Hague became the residence of the States-general, the stadtholder, and the foreign ambassadors. The Hague ranked only as a village till Louis Bonaparte, during his reign, conferred on it the privileges of a city. The population in 1880 was 127,931.

Cannon casting, printing, and various manufactures are carried on, but the Hague is not important as a commercial or manufacturing city, depending for its prosperity almost entirely on the court and nobility. William III. of England, and Huyghens the mathematician, were born at the Hague. In the immediate neighbourhood are Ryswick, celebrated for the treaty of peace signed there in 1697, and Scheveningen, a famous bathing place on the sea-coast, 2 miles from the town, with which it is connected by a broad causeway, planted with rows of trees.

HAH'NEMANN, SAMUEL, founder of the system of medicine called HOMŒOPATHY, was born at Meissen, in Upper Saxony, on the 10th April, 1755. His father, Gottfried Hahnemann, who was an artist of considerable merit, was employed in the painting of China in the celebrated porcelain manufactory of Meissen. The boy was placed at an elementary school, the director of which, Dr. Müller, remarking talents that only required cultivation to raise him to eminence, persuaded his father to place him at the High School of Meissen, into which they obtained him a free admission. Hahnemann gladly availed himself of these increased facilities; he made himself master of Latin, Greek, and Hebrew, and evinced a decided bias for the study of the physical sciences, natural history, and medicine. Botany was also a favourite pursuit, and his hours of leisure were devoted to the collection of plants and their systematic arrangement.

Having chosen medicine for his profession, at the commencement of 1775 he left the High School of Meissen, and entered the University of Leipzig.

He supported himself during his residence at Leipzig by giving lessons in German to foreign students, and by the translation of English and French medical authors. Having passed two years in the study of the theory of medicine, and saved a small sum of money, he departed for Vienna, there being no clinical lecturer in the University of Leipzig, and entered himself at the Hospital of Charitable Brothers, with a view to the completion of his studies and to acquiring a practical knowledge of his profession.

His moderate pecuniary resources were almost exhausted when his talents and marked attention to his duties gained for him a firm friend in Dr. Quarin, physician to the Emperor of Austria and chief physician to the hospital, through whose recommendation, although he had not yet

graduated, Hahnemann obtained the situation of family medical attendant and librarian to Baron von Brückenthal, governor of Siebenbürgen, then residing at Hermannstadt. He remained here for two years, and being allowed to attend private practice he saved a small sum of money; with this he removed to Erlangen, where, on the 10th of August, 1779, he took his degree of M.D. In 1781 he was appointed district physician at Gomern, near Magdeburg, where he married.

In the year 1784 he removed to Dresden, where he gained a high reputation in the hospitals as a judicious and skilful practitioner; but, struck with the absence of a guiding principle in therapeutics and the great uncertainty of the healing art, he gradually withdrew himself as much as possible from practice, and endeavoured to support his family by his old resource of translations of English and French medical authors, pursuing at the same time his favourite study of chemistry.

In the year 1790, while engaged upon the translation of the "Materia Medica" of Cullen, he was struck with the different explanations given of the mode of operation of Peruvian bark in intermittent fever; and, dissatisfied with them, he determined to try its effects upon himself. On finding that powerful doses of this substance produced symptoms strikingly analogous to those of that form of intermittent fever for which it was an acknowledged specific, he determined to try further experiments with other medicinal substances upon himself and upon some medical friends. He obtained similar results; that is, he produced by these agents factitious or medicinal disorders resembling the diseases of which they were esteemed curative; and thus the first dawn of the law of *Similia similibus* gleamed upon him. Further experiments convinced him that in order to obtain the best results it was necessary to administer medicine in minute doses, and this idea he pursued until it led him to recommend the use of such infinitesimal quantities as the decillionth of a grain.

In 1801 he published a short treatise on the efficacy of belladonna in the prevention and cure of scarlet fever, and affirmed that its curative properties were based upon the homœopathic law. In 1810 he brought out his great work, "The Organon of the Healing Art," in which he developed his new system of treating disease, and for the first time gave it the name of "Homœopathy," by which it has since been distinguished.

In the year 1812 he returned to Leipzig, where he was appointed Magister Legens. At Leipzig he had an extensive practice, and was assisted by a great number of friends and pupils in the proving of his medicines. The apothecaries of that city, however, rose against him, and appealing to an old law long dormant that forbade a physician to dispense his own prescriptions, they eventually, after some litigation, succeeded in 1820 in obtaining a decision in their favour. Hahnemann, unwilling to risk his own reputation and that of his system by medicines prepared and dispensed by individuals avowedly hostile to his medical tenets, had determined to retire from practice, when the Duke of Anhalt-Köthen offered him an asylum in his dominions, with the enjoyment of those privileges of which he had been deprived at Leipzig.

Having been a widower for some years, he married in 1835 a French lady, who had visited Köthen for the benefit of his advice, and with her removed to Paris. He remained there in the exercise of his profession, and surrounded by numerous followers of his system of all nations, till the time of his decease, which took place on the 2nd July, 1843, in the eighty-ninth year of his age. On the centenary of his birth, in 1855, a statue was erected to his honour in Leipzig at the expense of his disciples in England, France, Germany, and other countries, with the concurrence of the local authorities, who supplied the site in one of the best places in the town.

HAIL. "Hail—frozen rain" was the quick and summary fashion of describing this extraordinary natural product in the old-fashioned spelling-book. But the truth is we know as yet nothing about hail until we see it before us on the ground. It at once divides itself into *true hail* and *soft hail*. The latter is what falls tolerably frequently in winter and spring, and is made of little lumps of softish ice more or less rounded. It may perhaps really be frozen rain drops.

True hail is irregular in shape, its stones frequently showing a congeries of ice-crystals on the outside, and when cut open revealing alternate layers of hard and soft ice. As they thaw in falling the shape of hailstones is frequently roughly spherical. The size of true hailstones varies from quite a small spheroid to masses as large as hens' eggs; but examination leads us to feel almost certain that the larger stones are formed by the coalescing of several small stones during falling. Often a concentric lamellar structure forms a core, surrounded by numbers of crystalline pyramidal forms, more or less blunted by melting by the time they reach the earth. The showers of wedge-shaped or pyramidal hail which sometimes occur are believed to be produced by the bursting asunder of these large crystalline masses. See Plate SNOW AND HAIL.

The theories of hail are very various. Volta based a theory upon the constant association of hail with thunderstorms, and supposed the hailstones were flung to and fro between the opposing electrical clouds until their growing size overcame gravity and they fell. Others, struck with the alternation of hard and soft layers, suppose that hailstones are made in a cyclone whirling round on a horizontal axis, so that the watery particles are alternately exposed to a low warmer stratum and a cold higher one, until they grow heavy and fall. There is (perhaps happily) very little chance in our country of arriving at a true theory, for the equable temperature which we owe to the fact of the sea surrounding our country prevents this disastrous form of storm from often visiting us. It is probable that hail is formed something like *verglas* (glazed frost). That is, the water always suspended in the atmosphere is by some means chilled below freezing-point; and in this state it resembles the well known condition of a saturated solution of a crystal, ready at once to throw itself into the solid form if motion be given to it, even by touching it with a needle. If, then, particles of ice-cold moisture at a temperature below zero, yet nevertheless still remaining fluid, are exposed to wind they will at once congeal, and naturally those near one another will run together into a mass. But the complicated structure and the rapid formation of the larger stones implies something farther not yet explained. All other crystals that we know are very slowly laid down.

The most remarkable hailstorm on record is that which occurred in France on the 13th of July, 1788. It was divided into two distinct bands—the western one 420 miles long and 10 miles broad; and the eastern one 500 miles long and only 5 miles broad. There was a mean interval of 12 miles between them, in which space rain fell. The storm moved at the rate of 32 miles per hour, the hail falling for not more than seven or eight minutes at the same place. The western branch began at Touraine, near Loches, at half-past six a.m., passed over Chartres, Rambouillet, Pontoise, Clermont, Douai, entered Belgium, and passed over Courtrai, and finally died out beyond Flushing at half-past one p.m. The eastern branch began at Orleans at half-past seven a.m., passed over Arthenay and Andonville, reached the Faubourg St. Antoine in Paris at half-past eight, Cressy-en-Valois at half-past nine, Cateau-Cambresis at eleven, and Utrecht at half-past two p.m. Though the hail fell for such a short time at each place, the destruction of property was immense. No less than 1039 communes in France suffered, the damage being

found to amount to about £1,000,000 sterling. Some of the hailstones weighed more than half a pound. There are several very remarkable features in this hailstorm: its extraordinary length, its comparatively narrow width, and its short continuance at one place. These peculiarities might be conveniently accounted for by supposing an immense cloud or body of clouds carried along by a steady current of wind, and discharging as it moved in its course. But how can we conceive a single cloud bearing along in its bosom nearly 28,000,000 tons of ice?—which was about the quantity, estimating it at one pound per square foot, that fell to the earth during the storm.

The hailstorm which occurred at Richmond, very early on the morning of 3rd August, 1879, is the worst English well-authenticated example. It covered a belt 7 miles long by 2 broad, and destroyed much property. Glass was broken, to mention the worst item of damage, to the value of £30,000. The storm lasted only about ten minutes, but the stones were some of them too big to go into a wineglass, and the average size was over $1\frac{1}{2}$ inch in diameter. It would seem probable, as said above, that these stones are formed by the coalescing of smaller stones; and this would also account for the peculiar crackling noise always immediately preceding a severe hailstorm.

HAINAN′, an island in the Chinese Sea, opposite the southern extremity of the province of Quan tung, or Canton, from which it is divided by the Channel of the Junks, a strait only 15 or 16 miles wide. It lies between 18° 10′ and 20° 24′ N. lat., and 108° 25′ and 111° E. lon., and closes the Gulf of Tonquin on the east. Its length from south-west to north-east may be about 200 miles, and its average breadth perhaps not less than 100 miles; its surface is estimated to cover an area of 12,000 square miles.

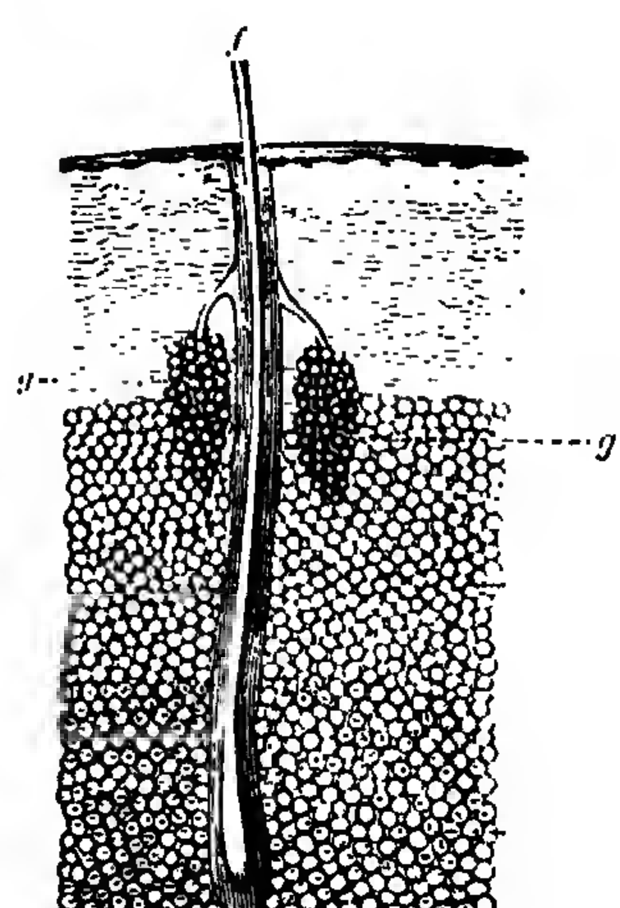
The interior of the island is occupied by an extensive mountain mass (some parts of which rise above the snow-line) called Ta Utshi Shan, or the Great Utshi range; from this there issue a great number of offsets, which are separated from the south-eastern and north-western shore by a level tract of considerable width. The extensive forests which cover the sides of the mountains form the principal wealth of the island. The climate is not very hot, being exposed to the wind which blows over a large expanse of sea. Fogs and heavy dews are frequent, and maintain a vigorous vegetation.

The population probably comprises 1,000,000 Chinese, exclusive of aboriginal wild tribes in the interior, who are practically independent. In the south are several good harbours. Exports—rice, sugar, wax, pearls, coral, salt, gold, silver, and timber. There are large rivers, but the soil is not fertile, timber being the principal product. The island is divided into thirteen districts. Kiong-tchou, the capital, is a populous city on the northern coast, containing, it is estimated, 100,000 inhabitants. It is inclosed by strong walls, and has a trade with Macao, Assam, Siam, and Singapore. Its port, Kinag-chow, is one of those opened by the treaty of Tientsin. Near the island whaling is pursued with great success by Chinese fishermen.

HAINAULT (*Hene-gowcen*), a province of Belgium, is bounded N. by East Flanders and South Brabant, E. by Namur, S. by France, and W. by West Flanders; its greatest length is 63 miles, and its breadth 32 miles. The area is about 1400 square miles, and the population in 1881 was 977,562. This province is extremely rich in coal, and contains the three principal mines in the kingdom. The surface is for the most part level, but there are some hills towards the south and east. The soil, except in the arrondissement of Charleroi, in the south-east of the province, is very fertile. The chief crops are wheat, rye, oats, barley, beans, rape, flax, hops, and potatoes; tobacco and chicory are also grown. Much of the land near the rivers is laid out in meadow; in other parts trefoil, lucerne, and sainfoin are cultivated. Horned cattle, horses, and sheep of excellent breed are numerous; poultry, game, and bees abound. The Scheldt enters the province from France a little below its confluence with the Scarpe, and flows north-west to Tournay; then changing its course to north it forms the boundary line between Hainault and West Flanders, and quits the province at its north-western angle. The Sambre enters the province also from France, to the east of Maubeuge, and flows north-east past Charleroi to join the Meuse at Namur. The Dender rises within the province, flows eastwards to Ath, whence it turns almost due north, quitting Hainault at Grammont, and, having crossed a great part of East Flanders, enters the Scheldt at Termonde. The Haine, from which the name of the province is taken, is formed by three brooks, which rise a little to the west of Charleroi; it flows west past Mons, below which it is navigable by means of sluices, and joins the Scheldt at Condé in France. The Trouille rises on the southern frontier, and flowing west enters France, but leaves it again almost immediately, and falls into the Haine near Jemappes.

The province is traversed by several good roads and numerous canals, and is well supplied with railways. The commerce of the province is composed of its varied industrial pursuits—glass, porcelain, pottery, salt, spirits distilled from grain, beer, machinery, woollen stuffs, linen, lace, Brussels carpets (the great manufacture of which is in Tournay), &c. The most considerable articles of export are coal, iron, and lime, which are transported by canals and railways to France and the neighbouring countries. Slates, marble, and building stone are quarried. The province is divided into three arrondissements, Mons, Tournay, and Charleroi. The principal town is MONS.

HAIR is a modification of the epidermis or horny layer of the skin of animals. Hairs are composed of long delicate processes of a horny substance, which grow from bulbs situated in or beneath the skin. Each hair is contained at its lower part in a delicate sheath or follicle, which



passes obliquely from the surface of the skin on which it opens to a greater or less depth, and at its base dilates into a pouch containing the bulb of the hair. The bulb of the hair consists of a small cone-shaped body or papilla of the true skin. On the whole surface of this papilla the substance of the hair is secreted, and as each layer which is deposited pushes that previously formed onwards, the

whole gradually advances along the sheath till it projects beyond the skin, and thence continues to grow free. Into each hair-follicle there open the ducts of one or two little glands, by which the oily matter is secreted to lubricate the hair and keep it supple and firm, and where these are deficient the same purpose seems to be performed by the base of the follicle itself. Externally a hair is covered by a layer of finely imbricated scales with the free edges turned upwards, called the cuticle of the hair; and within the cuticle is a mass of close horny scales, usually solid in human hair. In other hairs, especially the coarser kinds, there is a central medulla or pith. The hair-follicle is lined by epithelial cells continuous with those of the epidermis; in fact it is but a depression of the skin, as it were the finger of a glove. Now the hair-cuticle is imbricated upwards, as anyone may tell by the ease with which a hair is drawn through the fingers from base to tip, and the resistance experienced on drawing it in the opposite direction. The lower part of the follicle, called the sheath, presses tightly round the hair and is also imbricated, but in the opposite direction. The hair therefore interlocks with the sheath, and the hair is held very firmly in its follicle. Indeed, if hairs are plucked out the sheath usually accompanies the hair. The illustration in the preceding page shows a section of the skin, containing a hair from the human scalp; here *a* is the thin cuticle, *b* the cutis, *c* the subjacent fat, *d* the cellular tissue, in which the base of the hair-follicle, *e*, is seen; *f* is the hair itself, enlarged at its base, and *g g* are two sebaceous glands opening into the sheath.

In man the hairs are not, as has been generally supposed, perfectly cylindrical. They are all more or less flattened, so that a transverse section presents an elliptical form, or sometimes, from one side being grooved, has the shape of a bean. The hair of the whiskers, beard, and moustaches, and in general all short curly hair, is most flattened. Very often flatness and curliness are directly proportionate, and both attain their maximum in the crisp woolly hairs of the negro, which are sometimes as much as two-thirds broader in one direction than in the other. The hair of the negro, however, though called woolly, differs considerably from the wool, properly so named, of sheep and other animals; the latter is not spirally curled, but wavy, all its curves being nearly in the same place; it is much more delicate, and perfectly round, and hence, from its being equally fitted to curl in any direction, is peculiarly adapted for spinning, while the flattened hairs of men have always a tendency to turn their broadest surfaces towards the middle of the curl. The average diameters of hairs from the human head are respectively about 1-300th and 1-500th of an inch, and hairs often attain a length of 6 or 7 feet in women. (Instances are recorded also of the hair of the beard growing to a length of 9 feet.) This long hair of women is rightly reckoned as one great element of their personal charm, and is almost universally used as a means of adornment. See HAIRDRESSING.

Hairs are very elastic; they admit of being stretched nearly one-third of their length, and regain their original length almost completely: in proportion to their size they are very tough and firm. In masses they are impenetrable, except to very great violence, and hence one of their uses in the thick coverings of animals. Hairs are bad conductors of both heat and electricity, and their oiliness prevents the influence of moisture on the animal body. In fact, affording protection against blows by its elasticity, against extremes of heat and cold, dryness and moisture, or electrical disturbance by its insulating power, against each and all of them, hair is the most valuable covering of nature.

In chemical properties hair resembles the outer skin or epidermis, horn, nails, &c. It is soluble in water at a very high temperature, as in a Papin's digester, leaving a large quantity of oil mixed with sulphuret of iron and some sulphuretted hydrogen. It is this oil, with the sulphuret of iron, which gives the colour to the hair, and by whose absorption grayness is produced. The colouring matter is drawn directly from the blood. The iron is most abundant in the darkest hair, and the sulphur is the ingredient on which the action of the various black dyes for red or gray hair depends. The rest of the hair is gelatinous, taking that form of gelatin called *keratin*.

HAIRS OF PLANTS are long expansions of the cuticle, chiefly intended to answer the double purpose of collecting moisture from the atmosphere, and of protecting the surface of a plant from the too powerful influence of the sun's rays. They also assist in the conveyance of certain kinds of seeds through the air, and in other cases, as in that of cotton, they are specially adapted for the use of man. That the two first purposes are those for which hairs growing on the surface of plants are intended seems sufficiently indicated by the following facts:—Hairs are seldom found on water plants, which have no occasion for absorbing organs, and when water plants are accidentally obliged to grow in dry places they acquire them; while, on the other hand, species naturally found in hot dry places, or in arid climates, are as usually provided with them, unless in those cases where the cuticle becomes excessively thickened. If a hairy-leaved plant is observed in dry weather, it will be found that all its hairs are weak and flaccid; but no sooner does a shower of rain fall, or the atmosphere become humid, than the hairs acquire a rigid consistence.

In all cases hairs are composed of lengthened cells of cellular tissue, extending from one or more of the cells of the cuticle. Most commonly they are quite simple, and are merely formed of several cells of equally diminishing size, placed end to end, or of a single cell.

In consequence of the hairs of plants being an extension of cellular tissue, which is naturally thin-sided, all hairs are much weaker than the tough thick-sided tubes of which woody tissue is composed. This accounts for the well-known fact that all goods manufactured from cotton are far less tough and durable than those which, like linen, are prepared from the tissue of bark or wood. When the two forms of matter are submitted to microscopical examination, the thin sides and traverse partitions of the former will usually distinguish it from the thick-sided tubes of the latter, in which no partitions are discoverable.

HAIRDRESSING. The use of the hair as a covering and protection has already been referred to in this work [see BEARD and HAIR], but it may be here observed that its value as an ornament has also been recognized from the earliest times. The ancient Egyptians, who shaved the head and face, yet wore false beards and elaborate wigs; while their women, who allowed their hair to grow, bestowed great pains upon it, and wore it in innumerable tiny plaits down the back and the sides of the face. The Assyrians carefully cultivated both hair and beard, as may be seen from the representations preserved on their monuments, and the Greeks took great pride in their hair, and in the earliest times both men and women wore it long. Homer speaks of the "long-haired Achaians." But later, at Sparta, boys were cropped close and the hair of men only allowed to grow—a fashion abandoned in its turn when northern influences under the Achaian League at length prevailed over Spartan isolation; for the custom was the reverse in Athens at any time after the Persian wars: only dandies like Alcibiades ventured to wear their hair falling on their shoulders. The Jews seem to have observed the distinction of the sexes in this respect, the men clipping their hair short and the women allowing theirs to grow; but the beauty and length of Absalom's hair is carefully noted by the historian in his description of that prince. Certain religious observances also were connected with the hair, a

certain method of cutting being prohibited (Lev. xix. 27), and the Nazarites were commanded to allow theirs to grow unrestrained. The part played by the locks of Samson is too well known to need repetition. The descendants of these ancient Jews, or at least the fairer half of them, appear to have given great trouble to their religious guides by their inordinate hairdressing. In vain does St. Paul plead that the hair of women is meant as a veil or covering, or does St. Peter warn them, as in 1 Pet. iii. 3, where we read, "Whose adorning let it not be that outward adorning of plaiting the hair, but the hidden," &c., and so in many other places of Scripture. The "plaiting" here denounced would probably be in the Greek or Roman style; and never were there more beautiful modes of heightening this "adornment" than those used by the ancient Greeks and their imitators, the Romans.

In fact this question of the hairdressing of ladies is an instance of there being "nothing new under the sun." For we read in Greek of cosmetics and fashions innumerable, and among the more luxurious Romans the tricks played with the hair were innumerable, and form a favourite topic for the satirist. Now it is the variety of styles, which Ovid compares to the acorns on a huge oak in number; now the masses of false hair, even extending to the *statues* of the empresses in some instances—that is to say, the marble hair was removable so as to be replaced by the fashion as required! Dyeing the hair began with the Roman dames as early as Cato the Censor, when reddish-yellow was the "only wear," a colour obtained from the use of caustic soap imported from Gaul. Later on other colours prevailed each in turn. Ribbons, pins, threads of gold cord or strings of pearls, wreaths, and carved combs were regular parts of the toilette; lists of special pomatums, kept closely secret, are preserved. The Empress Plotina had five-and-twenty. The long fair hair of the German slaves captured in the later wars pleased these Roman ladies, and a rage for wigs set in. Among the Romans the men's hair was worn long up to about 300 B.C., when short hair became fashionable and shaving the face was also practised. Scipio Africanus was the first Roman who shaved. The barbers were Greeks and came from Sicily. The fashions of men's hair under the emperors were almost as finical as those of the ladies. Portraits of Mark Antony show him with rows of curls carefully arranged in lines round his head. False hair was used even by men, or in other cases bald pates were painted with fictitious locks, which looked very well at a distance (Martial's "Epigrams," vi. 57). The Emperor Gallienus used to have his hair powdered with gold dust. By Hadrian's time full beards and short hair came again into vogue, and continued so to the end of the empire. The Teutonic tribes are described as wearing their hair long, as did the ancient Britons and Gauls. The part of Gaul

Roman

Modes of Dressing Ladies' Hair among the Ancients.

furthest removed from Roman influence was called from this reason *Gallia comata* (long-haired Gaul), as distinguished from the half-Roman *Gallia togata* (gowned Gaul). The Saxons and Danes also wore long hair and allowed their beards to grow, but the Normans shaved their chins, and sometimes the back of their heads also. In the reign of Henry I., according to an ancient chronicler, the gentlemen vied with the ladies in the length of their hair; but as the latter sometimes had plaits that reached to their knees, they must have in this, as in most other contests, come off victorious. The wearing of long hair by men seems to have prevailed until the time of Henry VIII., when short hair came into fashion in England. During the reign of Charles I. the wearing of long ringlets or love-locks became very fashionable among the Cavaliers, while the Puritans, by way of testimony against such extravagances, cropped their heads closely. About the close of the seventeenth century the ladies wore their hair in ringlets, and the wearing of elaborate perukes became fashionable among gentlemen. The latter custom continued to exist until about 1760, lasting nearly a hundred years. The female fashion of wearing the hair reached perhaps its highest pitch of absurdity during the latter half of the eighteenth century, when the custom of raising it above the head was introduced from France. The erections worn at first were comparatively moderate in size, but they rapidly increased in bulk and extent, until a fully fashionable head-dress towered quite 3 feet above the crown of the head! As the hair had to be plastered together by means of a mixture of pomatum and meal, and stretched over a mass of tow or wool, the discomfort of the wearer can be better imagined than described. As the hairdressers at this period were at the zenith of their prosperity, the cost of a dressing became a serious matter, and not to be incurred more often than once a week or once a fortnight. One result of this was that poisonous compounds designed for the destruction of certain parasitic insects became in great request, and many such were freely advertised in the journals of that period. It is also recorded that owing to the length of time required for the operation of dressing a lady's hair, it was often necessary to have it done two or three days before any important ball or public gathering, the services of the fashionable hairdressers being in such great request. To preserve the results of their art unblemished the ladies had to remain up during the nights that intervened, and get what sleep they could in such positions that the hair was not disturbed. Before 1786 the size of the head-dress had begun to abate considerably, and a year or two later a new fashion of wearing the hair in long curls had come into vogue. Subsequent fashions must be passed over without special notice, and the modes in use at the present day vary so greatly and so frequently as to render any description impossible. After the French Revolution short hair became common among males, and at the present day close cropping is almost universal. Many Eastern nations shave the head. Thus Buddhist priests rejoice in complete artificial baldness; and all Mohammedans shave the whole scalp except one tuft of hair—left,

they say, to enable the angel of death to hold by as he conveys them up to paradise. As to the TONSURE of Roman Catholic priests, see that article.

For methods sometimes adopted with a view to strengthening and preserving the hair see BALDNESS; but as yet nothing very definite is known on this subject.

HAIR MANUFACTURES. There is a considerable amount of industry bestowed upon human hair and the hair of certain animals in the production of manufactured articles. These consist of fabrics woven or felted of various kinds of hair, brushes, and ornamental hair-work. The latter are chiefly wigs, false curls, numerous contrivances for supplying a deficiency of hair, or giving an appearance of greater abundance to the natural supply, chains, guards, and hair-jewelry. There are hair merchants in France who collect it from the various departments, and also from Holland and Germany. In the spring of the year quite a harvest of hair is raised, chiefly in the country districts, at an average price of about 5 francs per lb., but choice tresses fetch more.

Hair brushes are of many kinds, the coarsest being made of pigs' bristles, of which 2,000,000 lbs. are annually imported, nearly all from Russia. They are chiefly used in the manufacture of hair and clothes brushes, tooth and nail brushes, brooms, and coarse brushes. The finer sorts are made of the hair of the camel, goat, badger, dog, &c. These require great care in sorting into the different lengths. The value of artists' and painters' brushes consists in their fine points.

Horse-hair forms an important article of commerce, and is imported in large quantities from South America, Russia, and Germany. The shorter kinds are used for stuffing sofas, chairs, &c.; and horse-hair cloth is woven of hair taken from the tail. If the hair be white, as in Russian horses, it admits of being dyed green, crimson, &c., by carefully conducted processes; but black or gray horse-hairs only admit of a black dye, which is done by logwood and copperas. The process of weaving is a tedious one, for each hair usually constitutes only one throw or thread of weft. It can only be used for the weft, except for sieve-cloth; the warp being either worsted, cotton, or linen yarn. Hair-cloth is used for covering seats of chairs, couches, and as a material for making bonnets. Horse-hair is also made into ropes, sacks, and bags. Cow-hair is worked into a rough yarn and woven into carpets in Germany, made into socks in Norway, and used for stuffing furniture and mixing with mortar in Britain.

In the coarser manufactures various substances are used as substitutes for hair, such as aloe fibre, dyed hemp and flax, and China grass. One peculiar application of hair may be briefly noticed. The Russians work up the hair of rabbits and hares into a kind of felt, press or fashion it into bowls, dishes, plates, and other articles, and varnish it thickly. The materials thus made have the appearance of *papier maché* or varnished leather, and are strong, light, and durable.

HAIR-POWDER is made from starch, and scented with a dry perfume. In the seventeenth century the fashion of powdering the hair was almost universal among both sexes of the higher ranks of society. It originated in France, in what manner is not exactly known, and gradually became fashionable in Europe. The hair was well greased with pomade to make the powder stick. In 1795 hair powder was taxed, and yielded about £20,000 per annum, but it had the effect of altering the fashion by a return to unpowdered hair. Some of the nobility and gentry of the present day oblige their footmen and coachmen to wear it as part of their livery, for which they formerly had to pay a tax of £1 3*s.* 6*d.* each. The tax latterly yielding less than £1000 per annum, it was abolished in 1869.

HAIR-STREAK is the common name given to species of BUTTERFLIES belonging to the genus Thecla and the family Lycænidæ. The hair-streaks are small graceful butterflies, distinguished by a short tail-like projection to each hind wing. It is from the pale hair-like lines on the under surface that these butterflies have acquired their name of hair-streaks. The Brown Hair-streak (*Thecla betulæ*) is the largest species, measuring more than 1½ inch across the expanded wings. The male is of a deep brown colour, but the female has a deep large patch of orange on the front wing. The under surface is tawny and marked with one white line on the front wing and two on the hind wings. This butterfly appears in August; it is not very common in this country. The White Letter Hair-streak (*Thecla* W *album*) is also a rather uncommon species here. This butterfly is brown above; the under surface is orange with a wavy white line across the wings, forming a distinct W at the lower corner of the hind wing. The Green Hair-streak (*Thecla rubi*) is found rather abundantly throughout this country. It is double-brooded, appearing first in May and June and again in August. It is found in open woods and heaths, settling on brambly hedges. It is distinguished by the bright green colour of the under surface and by wanting the tails to the hind wings. The Purple Hair-streak (*Thecla* or *Zephyrus quercus*), the commonest of these butterflies, is found in oak woods. The male has the upper surface of a dark brown colour, but with a change of position a rich purple tint lights up all the wings with the exception of a narrow black margin. The female has a very rich purple patch on the fore wings.

HAIR-TAIL (Trichiurus) is a genus of fishes belonging to the order ACANTHOPTERYGII, the type of the family Trichiuridæ. The hair-tails inhabit tropical seas, but extend also into those of the temperate zone. The Silvery Hair-tail (*Trichiurus lepturus*), common in the West Indies, is also found on our own coasts. The hair-tails have a long, band-like, tapering body without a caudal fin. The dorsal fin extends along the whole back. The anal fin is rudimentary and the ventrals absent. The hair-tails, six species of which are known, attain a length of about 4 feet.

HAIR-WORM. See GORDIUS.

END OF VOL. VI.

PRINTED BY WILLIAM MACKENZIE, 43 & 45 HOWARD STREET, GLASGOW.